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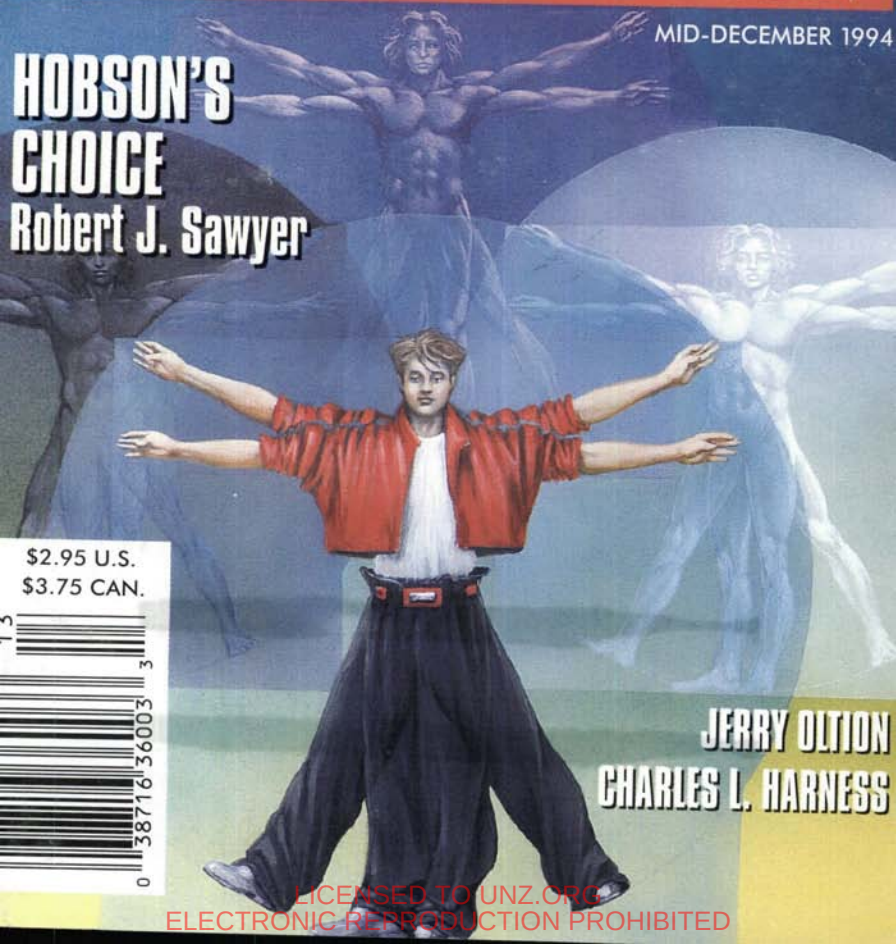

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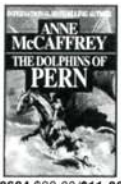

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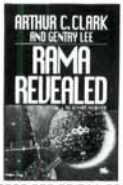

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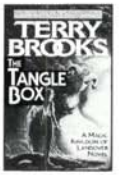

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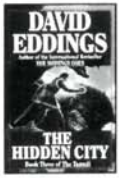

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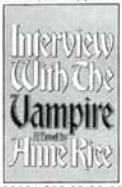

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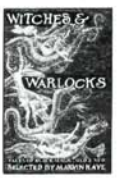

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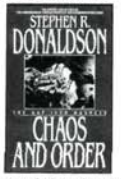

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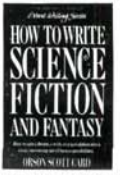

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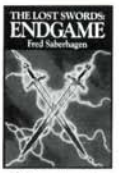

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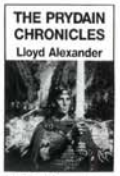

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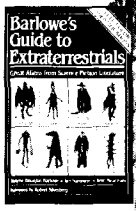

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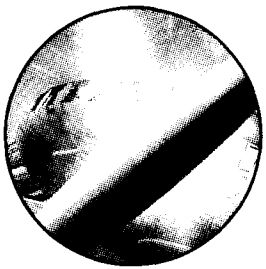

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EDITORIAL Stanley Schmidt

WISHFUL EGALITARIANISM

It often seems to me that most people in this country are driven principally by fads—and educators, unfortunately, are no exception. Like other fads, those in education tend to fade out after a while, replaced by new ones, which people hope will avoid the shortcomings of the old. Then they resurface a few years later, incorrectly relabeled "new."

One of the latest resurfacings is one that I'd really (if naively) hoped we'd seen the last of: "heterogeneous grouping," a movement to do away with "ability-grouping" or "tracking" in schools. Throwing everyone of the same age together in the same classes has been around before, of course, many times. From time to time it gets replaced by a system that attempts to assemble classes geared to students of similar abilities or achievement levels. The arguments for such ability-grouping include the claim that a group of very bright, highly motivated students can accomplish more if they are with others of similar abilities. They can pursue more advanced material faster if they don't have to wait for slower students who lack the ability or interest to keep up with them. Conversely, slower students can achieve more if they aren't intimidated or pressured to keep up with those who are much faster.

From extensive experience as both student and teacher, I consider these arguments to have considerable merit. But whenever ability-grouping has been in place for a while, complaints start being heard, gradually building up pressure to try something else. The something else, commonly touted as new but actually quite old, is "heterogeneous grouping," or putting pupils in classes without regard to their abilities or achievement levels.

Where I come from, we call this "ignoring relevant data," but the arguments advanced for it can be quite imaginative and occasionally amusing, in a grim, sad sort of way. One of the less ridiculous is the observation

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that ability-grouping, like type-casting, can become a self-fulfilling prophecy. Students placed in a group labeled "slow" may come to think of themselves that way, assume that it can't be changed, and play the role of slow learner for the rest of their lives. Those labeled "gifted" can, under some circumstances, get smug and figure they can rest on their laurels because they're "the smart ones."

It's a fact that these things can happen. It's also a fact that they don't have to—and that students really do differ in their abilities and achievements.

That's not a *popular* fact, in our present era of bizarre attitudes, but it *is* a fact. That's why the most fascinating argument that I've heard against ability-grouping is one that recently appeared in our local newspaper as a quote from the superintendent of a school system which is phasing it out. "If we don't do away with ability-grouping," he said, "we really can't have the belief that all children can learn."

Reread that closely. Evidently this person is more interested in propping up a belief than in giving people the best education. Sometimes, to some of us, *learning* as much as possible is more important than preserving a cherished belief—especially if the belief is wrong.

Oh, it's not completely and absolutely wrong; but it is wrong enough to do a lot of damage. From my own experience in teaching, I would agree that most people can learn, and in fact can learn more than they or most others think they can. But they can't all learn *equally;* and even if they could, they wouldn't—because some are more interested than others, despite the best efforts of even the best teachers. When I was teaching in classrooms, I considered it both an obligation and a point of pride to be able to do *something* for students all across the ability spectrum—but I could never deny that an ability spectrum exists.

It's not a one-dimensional spectrum, of course. People do have different strengths and weaknesses. I remember two physics students as a particularly good study in contrasts. One was extremely good at picturing conceptually what was going on physically, but unable to trust mathematical manipulations when the conceptual significance of every step wasn't easy to visualize (as one must often do in advanced physics). The

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other could manipulate symbols fluently and get any required mathematical result, but showed little conceptual understanding of what either the setup or the end result *meant*. Both did well, but in different areas and for different reasons.

In teaching several hundred students, I never met two whose minds worked quite the same way. For such reasons, there is probably a certain amount of validity in the desire of some teachers to have heterogeneous grouping so they can make up work groups consisting of students with complementary strengths.

But that validity is limited. The two students I mentioned were both intelligent people with the potential to be competent scientists, but each had strengths in specific areas that the other lacked. An "ideal" physicist would have all those strengths, but there are few ideal physicists (or ideal anything else). In a real work situation, either of those people might wind up on a team project, and a team with the two of them would function better than a team with two people like either of them. But it's hard to imagine a situation in which a team would be strengthened by pairing either of them with somebody who knew nothing about physics, had no aptitude for learning it, and no interest in trying.

And whether you like to admit it or not, there *are* such people.

It's probably true that a wide range of students can derive *some* benefit from heterogeneous classes—but not necessarily the benefits they should

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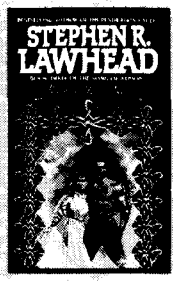

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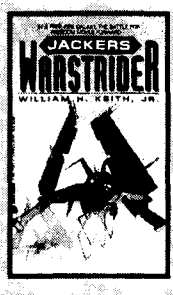

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be deriving. The first function of a math class is to help people learn math, not merely to feel good about themselves and each other. It's become fashionable to put a great deal of emphasis on the importance of building self-esteem. Unfortunately, an essential ingredient often gets left out of that goal. If you just want people to feel good about themselves, you can do that by force-feeding them suitable drugs—but I don't know many people who would seriously consider that good, either for the person being euphorized or for the civilization in which he or she lives.

What's important is not simply to help people feel good about themselves, but to help them *deserve* to feel good about themselves. I found that the very best thing I as a teacher could do for a student was to help, cajole, trick, or do whatever else it took to get him or her to accomplish something he didn't think he could. It works wonders, not only for self-esteem (and perhaps we should try to ease the term "self-*respect*" back into greater currency), but for instilling confidence and desire to go on and accomplish still more.

But that requires that, for example, a math class must teach people to do *math*, not just fill them with a warm fuzzy glow. And everything I've seen compels me to believe that that is far more likely to happen in ability-grouped classes than in sociable hodgepodges. Just what, you ask, have I seen that would make me say such a thing? Well, before teaching a variety of classes by a variety of methods, I spent a lot of time as a *student* in classes at all levels from kindergarten through doctoral.

In particular, I was in junior high and high school at a time when ability-grouping was just coming into one of its several vogues. As a result, my school offered some "accelerated" and "advanced placement" courses, but only in a few selected subjects. So I had some of those, and some regular, heterogeneous classes where students were simply scheduled where they would fit. I'm in an excellent position to make a side-by-side comparison of the two kinds of classes, from the viewpoint of a student who could and wanted to learn.

My verdict? The "advanced" classes made high school endurable; most of the "mixed" classes required all the endurance I could muster. The advanced classes actually taught me things I hadn't known. The mixed classes, in most cases, taught me little, if anything. And the difference wasn't just in the curriculum or the teachers, but in the company. The "regular" classes had so many "students" who were more interested in disrupting the class than in learning anything that the few who *wanted* to learn had an uphill battle. The advanced classes, on the other hand, were the first place where I had ever been able to sit in a whole room full of people who wanted to learn, respected learning, and *could* learn. That was an exhilarating, stimulating experience, and worth the price of admission even when (as occasionally happened) the formal curriculum content seemed silly or counterproductive.

So I must say, no, Mr. Superinten-

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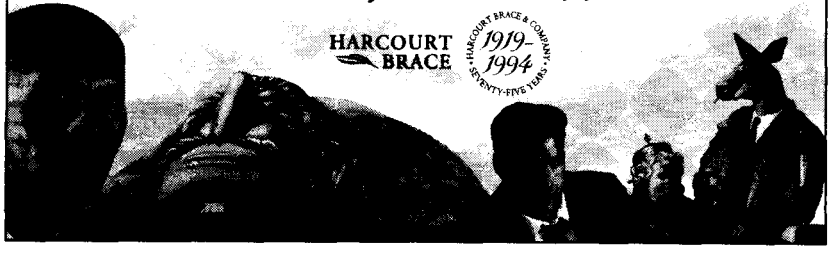

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dent, you *can't* have the belief that all children can learn, at least equally; and I'm appalled to hear that you are yet again determined to inflict on real children a system based on a wishful premise. All people are *not* created equal, except in certain very special senses. Effective education has to work with their real differences, not pretend they don't exist.

What about that concern that people once launched on one track will be stuck there forever, coasting or falling ever farther behind? It's a real concern, but it does not justify being afraid to build different tracks. It simply means that when you're doing so, you must also build in a mechanism for switching from one track to another. And you must make sure the teachers on *all* tracks watch their students closely enough to know when a track-jump should be considered. Students on the "fast track" must know that it does not mean a free ride from here on out; they must continue to perform on that level or they'll have to get off. And students on the "slow track" must know that they are not stuck there irrevocably. They must know that it is possible to move to a faster one if they show the ability and interest, and their teachers must watch for that ability and interest and nurture it wherever they find it.

And if all these things are done conscientiously, I'll bet on the resulting system to give a better education to more students than any system built on the wishful thinking that all people are equal in ways that they aren't. ■

Nature is trying very hard to make us succeed, but nature does not depend on us. We are not the only experiment.

—R. Buckminster Fuller

How dreadful it is when the right judge judges wrong.

—Sophocles

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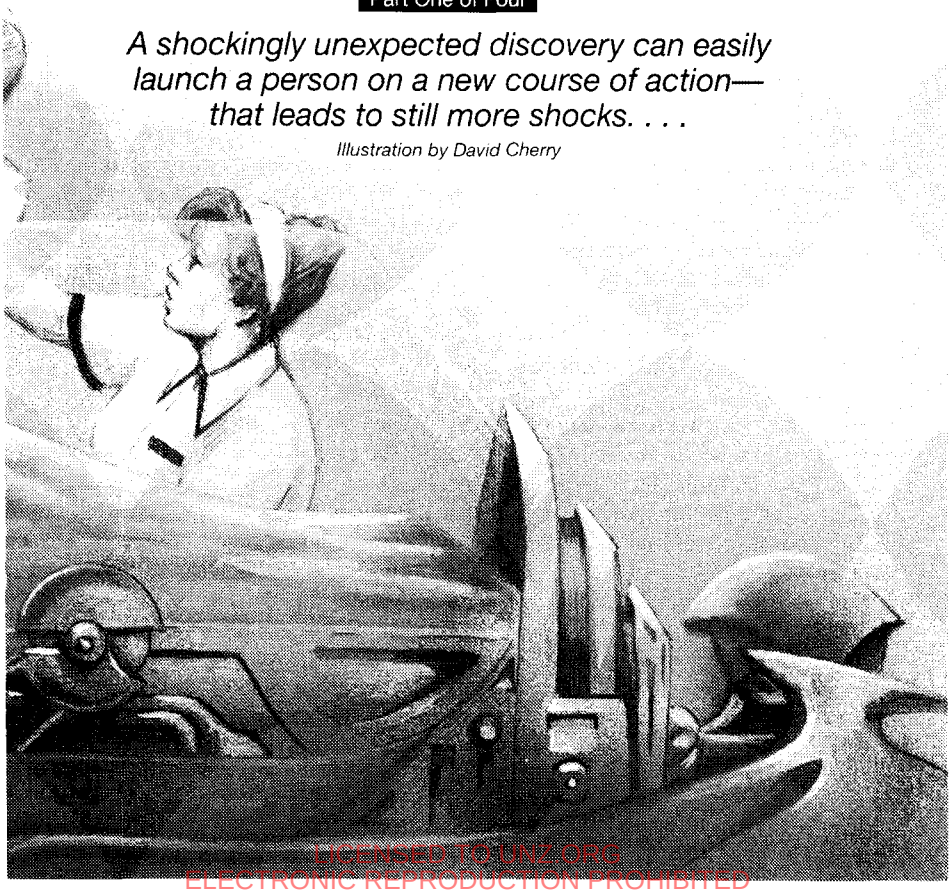
Robert J. Sawyer

HOBSON'S CHOICE

Part One of Four

A shockingly unexpected discovery can easily launch a person on a new course of action—that leads to still more shocks. . . .

Illustration by David Cherry



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In the last analysis, it is our conception of death which decides our answers to all the questions life puts to us.

—Dag Hammarskjöld
(1905-1961)
United Nations
Secretary General

PROLOGUE
December 2011

"What room is Detective Philo in?" asked Peter Hobson, a tall, thin man of forty-two, with hair an equal mixture of black and gray.

The squat nurse behind the desk had been absorbed in whatever she'd been reading. She looked up. "Pardon?"

"Detective Sandra Philo," said Peter. "What room is she in?"

"Four-twelve," said the nurse. "But her doctor has ordered that only immediate family members should visit."

Peter began walking down the corridor. The nurse came around from behind the desk and gave chase. "You can't go in there," she said firmly.

Peter turned briefly to look at her. "I have to see her."

The nurse maneuvered in front of him. "She's in critical condition."

"I'm Peter Hobson. I'm a doctor."

"I know who you are, Mr. Hobson. I also know you're not a *medical* doctor."

"I'm on the Board of Directors of North York General."

"Fine. Go over there and bully someone, then. You're not raising havoc on my ward."

Peter exhaled noisily. "Look, it's a matter of life and death that I see Ms. Philo."

"Everything in the ICU is a matter of life and death, Mr. Hobson. Ms. Philo is sleeping, and I'll not have her disturbed."

Peter pushed ahead.

"I'll call security," said the nurse, trying to keep her voice low so as not to alarm the patients.

Peter didn't look back. "Fine," he snapped, his long legs carrying him quickly down the corridor. The nurse waddled toward her desk and picked up the phone.

Peter found 412 and entered without knocking. Sandra was hooked up to an EKG; it wasn't a Hobson unit, but Peter had no trouble reading its display. A drip bag of saline was on a pole beside her bed.

Sandra opened her eyes. It seemed to take a moment for them to focus. "You!" she exclaimed at last, her voice raw and thin—the effects of the beamer.

Peter closed the door. "I've only got a few moments. They've already called security to come and take me away."

Every word was a struggle for Sandra. "You tried . . . to have me . . . killed," she said.

"No," said Peter. "I swear to you that wasn't my doing."

Sandra managed a weak shout, too faint to be heard through the closed door. "Nurse!"

Peter looked at the woman. When he'd first met her, only a few weeks ago, she'd been a healthy thirty-six-year-old, with flaming red hair. Now her hair was falling out in clumps, her

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complexion was sallow, and she could barely move. "I don't want to be rude, Sandra," Peter said, "but please shut up and listen."

"Nurse!"

"Listen, damn it! I had nothing to do with the murders. But I know who did. And I can give you a chance at getting him."

At that moment the door burst open. The squat nurse entered, flanked on either side by a burly security guard.

"Remove him," said the nurse.

The guards moved forward.

"Dammit, Sandra," said Peter. "This is your only chance. Give me five minutes." One guard grabbed Peter's upper arm. "Five minutes, for God's sake! That's all I ask."

"Let's go," said the guard.

Peter's tone was imploring. "Sandra, tell them you want me to stay!" He hated himself for what he said next, but he couldn't think of anything more effective: "If you don't, you'll die never having solved the crimes."

"Come along now, buddy," said the guard gruffly.

"No—wait! Sandra, please!"

"Come along—"

"Sandra!"

Finally, a voice weak and wan: "Let . . . him . . . stay."

Peter twisted free of the guard's grip. "Thank you," he said to Sandra. "Thank you."

The nurse scowled at him. "I won't stay long," Peter said to her. "I promise."

Sandra managed to roll her head slightly in the nurse's direction. "It's . . . OK," she said, faintly.

The nurse was seething. The tableau held for several seconds, then the woman nodded. "All right," she said, perhaps the talk of police business and unsolved crimes convincing her she was out of her depth.

"Thank you," Peter said to the nurse, relieved. "Thank you very much."

The nurse scowled, turned heel and left, followed immediately by one of the guards. The other guard backed out, his face an angry mask, all the time pointing a warning finger at Peter.

When they were alone again, Sandra said, "Tell . . . me."

Peter found a chair and sat down beside her bed.

"First, let me say I'm terribly, terribly sorry about what's happened. Believe me, I never wanted you or anyone else to come to harm. This—this is all out of control."

Sandra said nothing.

"Do you have any family? Any children?"

"Daughter," said Sandra, surprised.

"I didn't know that."

"With my ex now," she said.

"I want you to know I'm going to take care of her financially. Everything she needs—clothes, cars, university, vacations in Europe, whatever. I will pay for it all. I'll set up a trust fund."

Sandra's eyes were wide.

"I never intended any of this, and I swear to you that I've tried repeatedly to stop it all."

Peter paused, thinking back to how the whole damned thing had started.

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Another hospital room, trying to comfort another brave woman who was dying. It comes full circle.

"Sarkar Muhammed was right—I should have come to you before. I need your help, Sandra. This has to end." Peter exhaled, wondering where to begin. So much had happened. "Did you know," he said at last, "that it's possible to scan every neural net in a human brain and produce an exact duplicate of the subject's mind inside a computer?"

Sandra shook her head slightly.

"Well, it is. It's a new technique. Sarkar Muhammed is one of its pioneers. What would you say if I told you that my brain had been scanned and duplicated?"

Sandra lifted her eyebrows. "Two heads . . . better than one."

Peter acknowledged the comment with a wry smile. "Perhaps. Although, actually, a total of three simulations of me were made."

"And one of these . . . committed . . . murders?"

Peter was surprised by how quickly Sandra grasped it. "Yes."

"Thought AI . . . was involved."

"We've tried to stop them," said Peter. "Nothing worked. But at least I now know which simulation is guilty." He paused. "I'll give you everything you'll need, Sandra, including full Q&A access to the scans of my brain. You'll get to know me in intimate detail, better than anyone in the real world knows me. You'll know how I think, and that will give you the knowledge to outwit the murdering simulation."

Sandra lifted her shoulders slightly. "Nothing I can do," she said, her voice weak and sad. "Dying."

Peter closed his eyes. "I know. I'm terribly, terribly sorry. But there *is* a way, Sandra—a way for you to end all this."

CHAPTER 1
January 1995

Sandra Philo probed the memories of Peter Hobson.

The horror, she learned, had started in 1995, sixteen years ago. Back then, Peter Hobson hadn't been the center of a controversy about science and faith that was shaking the world. No, back then he was simply a twenty-six-year-old grad student at the University of Toronto, doing his master's degree in biomedical engineering—a student who was about to have the shock of his life . . . .

The phone rang in Peter Hobson's dorm room. "We've got an eater," said Kofax's voice. "You up for it?"

An eater. A dead person. Peter was trying to get used to Kofax's callousness. He rubbed sleep from his eyes. "Y-yes." He tried to sound more confident: "Sure," he said. "Sure thing."

"Mamikonian's going to start the slice-and-dice," said Kofax. "You can ride the EKG. That'll take a good hunk out of your practicum requirements."

Mamikonian. Stanford-trained transplant surgeon. Sixty-something, hands steady as a statue's. Organ harvesting. Christ, yes, he wanted in on that. "How soon?"

"Couple of hours," said Kofax. "Kid's on full life support—keep the

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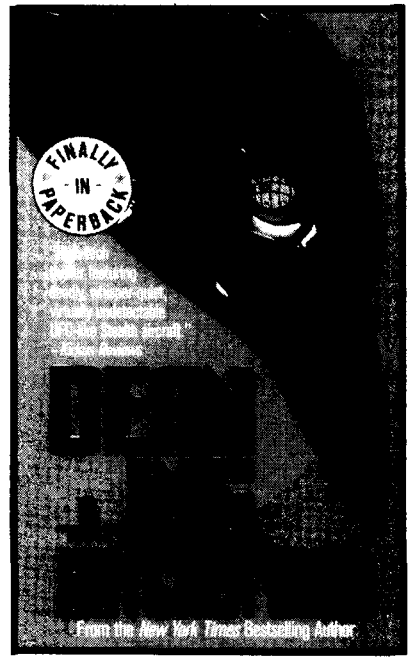

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meat fresh. Mamikonian is out in Mississauga; it'll take him that long to get here and prepped."

Kid, he'd said. Some kid's life cut short.

"What happened?" asked Peter.

"Motorcycle accident—kid was thrown through the air when a Buick sideswiped him."

A teenaged boy. Peter shook his head. "I'm in," he said.

"OR 3," said Kofax. "Start prep in an hour." He hung up. Peter hurried to get dressed.

He wasn't supposed to do it, Peter knew, but he couldn't help himself. On the way to the OR, he stopped at Emergency Admitting and checked the aluminum clipboards in the swivel-mounted rack. One guy being sewn up after going through a plate-glass window. Another with a broken arm. Knife wound. Stomach cramps. Ah—

Enzo Bandello, 17.

Motorcycle accident, just as Kofax had said.

A nurse sidled up to Peter and looked over his shoulder. Her name badge said Sally Cohan. She frowned. "Poor kid. I've got a brother the same age." A pause. "The parents are in the chapel."

Peter nodded.

Enzo Bandello, he thought. Seventeen.

In trying to save the boy, the trauma team had given him dopamine and had deliberately dehydrated him, in hopes of reducing the brain swelling normally associated with a severe head wound. Too much dopamine, though, would damage the heart muscle. According to the chart, at 2:14 A.M., they'd begun flushing it from his body and fluids were being pumped in. Latest reading showed his blood pressure was still too high—an effect of the dopamine—but it should come down soon. Peter flipped pages. A serology report: Enzo was free of hepatitis and AIDS. Blood count and bleeding studies looked good, too.

A perfect donor, thought Peter. Tragedy or miracle? His parts would save the lives of a half-dozen people. Mamikonian would take the heart out first, a thirty-minute operation. Then the liver—two hours' work. Next, the renal team would remove the kidneys, another hour's cutting. After that, the corneas. Then the bones and other tissues.

There wouldn't be much left to bury.

"Heart's going to Sudbury," said Sally. "Cross-matching was excellent, they say."

Peter put the clipboard back into the carousel and walked through the double doors that led to the rest of the hospital. There were two equally good routes to OR 3. He chose the one that went by the chapel.

He was not a religious person. His family, back in Saskatchewan, was white-bread Canadian Protestant. Last time Peter had been in church was for a wedding. Time before that, a funeral.

He could see the Bandellos from the hallway, seated in a middle pew. The mother was crying softly. The father had an arm around her shoulders. He was a deeply tanned man

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wearing a plaid work shirt with cement stains on it. A bricklayer, perhaps. A lot of Toronto's Italians of his generation worked in construction. They'd come over after World War II, unable to speak English, and had taken hard-labor jobs to make a better life for their kids.

And now this man's kid was dead.

The chapel was denominationally neutral, but the father was looking up, as if he could see a crucifix on the wall, see his Jesus hanging there. He crossed himself.

Somewhere in Sudbury, Peter knew, there was a celebration going on. A heart was coming; a life would be saved. Somewhere there was joy.

But not here.

He continued on down the corridor.

Peter arrived at the scrub room. Through a large window, he could see into the operating theater. Most of the surgical team was already in place. Enzo's body had been prepped: his torso shaved, two layers of rust-colored iodine painted on, clear plastic stretched over the surgical field.

Peter tried to get a look at that which the others had been trained to ignore: the face of the donor. Not much of it was visible; most of Enzo's head was covered by a thin sheet, exposing only the ventilator tube. The transplant team was deliberately kept ignorant of the donor's identity—made it easier, they said. Peter was probably the only one who knew the boy's name.

There were two scrub sinks outside the OR. Peter began the regulation eight minutes of washing, a digital timer above the sink counting down the time.

After five minutes, Dr. Mamikonian himself arrived and began scrubbing at the second sink. He had steel-gray hair and a lantern jaw—more like an aging superhero than a surgeon.

"You are?" asked Mamikonian as he scrubbed.

"Peter Hobson, sir. I'm a grad student in biomedical engineering."

Mamikonian smiled. "Good to meet you, Peter." He continued to scrub. "Forgive me for not shaking hands," he said, chuckling. "What's your role today?"

"Well, for our course work we're supposed to log forty hours of real-world experience with medical technology. Professor Kofax, he's my thesis advisor, arranged for me to operate the EKG today." He paused. "If that's all right with you, sir."

"That's fine," said Mamikonian. "Watch and learn."

"I will, sir."

The counter above Peter's sink bleeped. He wasn't used to this; his hands felt raw. He held his dripping arms out at chest height. A scrub nurse appeared with a towel. Peter took it, dried his hands, then stepped into the sterile green gown she was holding for him.

"Glove size?" she asked.

"Seven."

She tore open a package, removed the latex gloves, and snapped them onto his hands.

Peter entered the OR. Overhead, a dozen people were watching through the glass ceiling from the observation

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gallery.

In the center of the room was a table holding up Enzo's body. There were several tubes going into it: three volume lines, an arterial line to monitor blood pressure, a central venous line threaded into the heart to monitor hydration level. A young Asian woman sat on a stool, her eyes scanning the volume monitor, the CO_2 monitor, and the volumetric infusion pump.

Until his arrival, the woman had also been watching the EKG oscilloscope mounted above Enzo's head. Peter moved into position next to it and adjusted the contrast on the display. The pulse rate was normal, and there was no sign of damage to the heart muscle.

It chilled him. The guy was legally dead, and still he had a pulse.

"I'm Hwa," said the Asian woman. "First time?"

Peter nodded. "I've been in on a few little things before, but nothing like this."

Hwa's mouth was covered by a face mask, but Peter could see her eyes crinkle in a smile. "You get used to it," she said.

Across the room, an illuminated panel had Enzo's chest x-ray clipped to it. The lungs hadn't collapsed and the chest was clear. The heart, a silhouette in the center of the image, looked fine.

Mamikonian entered. All eyes turned to face him—the conductor for their orchestra. "Good morning, everyone," he said. "Let's go to work, shall we?" He moved in to stand over Enzo's body.

"Blood pressure's falling a bit," said Hwa.

"Crystalloid fluid, please," said Mamikonian, glancing at the readouts. "And let's add a little dopamine back in."

Mamikonian stood on Enzo's right, next to his chest. Across from him was the scrub nurse. A surgical assistant stood next to her, holding the abdominal-wall retractor. Five one-liter containers of ice-cold Ringer's lactate were lined up in a neat row on a table so they could be emptied quickly into the chest cavity. A nurse also had six units of packed red blood cells ready to go. Peter tried to stay out of the way near the head of the bed.

Next to Peter, the perfusionist, a Sikh wearing a large green cap over his turban, scanned a series of readouts labeled *remote temperatures, arterial vent,* and *cardiac sucker.* Nearby, another technician carefully watched the rising and falling of the ventilator's black bellows to make sure Enzo was still breathing properly.

"Let's go," said Mamikonian.

A nurse moved in and injected something into Enzo's body. She spoke into a microphone dangled on a thin wire from the ceiling. "Myolock administered at 10:02 A.M."

Dr. Mamikonian requested a scalpel, and made an incision starting just below the Adam's apple and continuing down the center of the chest. The scalpel split the skin easily, sliding through the muscle and fat until it banged against the breastbone.

The EKG shuddered slightly. Peter

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glanced at one of Hwa's monitors: blood pressure was rising, too.

"Sir," said Peter. "The heart rate is acting up."

Mamikonian squinted at Peter's oscilloscope. "That's normal," he said, sounding irritated at being interrupted.

Mamikonian handed the scalpel, now slick and crimson, back to the nurse. She passed him the sternal saw, and he turned it on. Its buzzing drowned out the blipping from Peter's EKG. The saw's rotating blade sliced through the sternum. An acrid smell rose from the body cavity: powdered bone. Once the sternum was cut apart, two technicians moved in with the chest spreader. They cranked it around until the heart, beating once per second, was visible.

Mamikonian looked up. On the wall was the digital ischemic counter; it would be started the moment he excised the organ, measuring the time during which there would be no blood flowing to the heart. Next to Mamikonian was a plastic bowl filled with saline. The heart would be rinsed in there to get blood off it. It would then be transferred into an Igloo container filled with ice for the flight to Sudbury.

Mamikonian requested another scalpel and bent down to cut through the pericardium. And, just as his blade sliced through the membrane surrounding the heart—

The chest of Enzo Bandello, legally dead organ donor, heaved massively.

A gasp escaped from around his ventilator breathing tube.

A moment later, a second gasp was heard.

"Christ—" said Peter, softly.

Mamikonian looked irritated. He snapped his gloved fingers at one of the nurses. "More Myolock!"

She moved in and administered a second shot.

Mamikonian's voice was sarcastic. "Let's see if we can finish this damned thing without the donor walking away, shall we, folks?"

Peter was dazed. Mamikonian departed with the excised heart. Since that meant there was no more need for an EKG operator, Peter went up to the observation level and watched the rest of the harvesting from there. When it was done—when Enzo Bandello's hollow corpse was sewn shut and rolled off to the morgue—Peter staggered down to the scrub room. He found Hwa, who was pulling off her gloves.

"What happened in there?" Peter asked.

Hwa exhaled noisily; she was exhausted. "You mean the gasping?" She shrugged. "Happens every once in a while."

"But Enz—but the donor was dead."

"Of course. But he was also on full life support. Sometimes there's a reaction."

"And—and what was that business with Myolock? What's that?"

Hwa was untying her surgical gown. "It's a muscular paralyzer. They have to administer that. If they don't, sometimes the donor's knees tuck up toward the chest as you carve into it."

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Peter was appalled. "Really?"

"Uh-huh." Hwa dropped her gown into the hamper. "It's just a muscular reaction. Nowadays, it's routine procedure to anesthetize the corpse."

"Anesthetize the corpse—?" said Peter slowly.

"Yeah," she said. " 'Course, Dianne obviously didn't do a good enough job today." Hwa paused. "It gives me the willies when they start moving like that, but, hey, that's transplant surgery for you."

Peter kept a little copy of the timetable for his girlfriend, Cathy Churchill, in his wallet. He was in the first year of his master's; she was in her last year of her bachelor's in chemistry. She would be finishing her final class of the day—polymers—in about twenty minutes. He hurried back to the campus and waited in the hall outside the classroom for her.

The class ended and Cathy came out, chatting animatedly with her friend Jasmine, who caught sight of Peter first. "Well," she said, grinning, and tugging Cathy's sleeve, "look who's here. It's Mr. Right."

Peter smiled at Jasmine briefly, but really only had eyes for Cathy. Cathy had a heart-shaped face, long black hair, and enormous blue eyes. As always, she smiled radiantly when she saw Peter. Despite what he'd seen earlier in the day, Peter felt himself grinning, too. It happened every time. There was an electricity between them—Jasmine and their other friends often commented on it.

"I'll leave you two lovebirds alone," said Jasmine, still grinning. Peter and Cathy said goodbye to her, and the two of them came together in a kiss. In that brief moment of contact, Peter felt himself revitalized. They'd been dating for three years now, and still there was wonder in each embrace.

When they separated, Peter asked, "What are you doing for the rest of the day?"

"I'd been planning to drop by the arts department to see if I could get some kiln time, but that can wait," Cathy said, her voice mischievous. Overhead, every other fluorescent tube had been removed to cut costs, but Cathy's smile lit up the whole corridor for Peter. "Got any ideas?"

"Yes. I want you to come to the library with me."

Again the wondrous smile. "Neither of us is that quiet," said Cathy. "Even if we did it somewhere that'd likely be deserted—the Canadian Literature section, maybe—I suspect the noise would still disturb people."

He couldn't help grinning, and he leaned in to kiss her again. "Maybe afterwards," he said, "but first, I need help with some research, please."

They joined hands and began walking.

"Into what?"

"Into death," Peter said.

Cathy's eyes were wide. "Why?"

"I was doing some more of my practicum today—running an EKG during an operation to remove a heart for transplant."

Her eyes danced. "That sounds fascinating."

"It was, but . . . ."

"But what?"

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"But I don't think the donor was dead before they started removing his organs."

"Oh, come on!" said Cathy, letting go of his hand long enough to whap him lightly on the arm.

"I'm serious. His blood pressure went up when the surgery started, and his heart rate increased. Those are classic signs of stress—or even pain. And they anesthetized the body. Think about that: they anesthetized a supposedly dead person."

"Really?"

"Yes. And when the surgeon sliced into the pericardium, the patient gasped."

"My God. What did the surgeon do?"

"Called for more muscular paralyzers to be injected into the patient, then just went on with the operation. Everyone else seemed to think this was all perfectly reasonable. Of course by the time the operation was finished, the donor really was dead."

They left the Lash Miller Building and started walking north toward Bloor Street. "And what do you want to find out?" asked Cathy.

"I want to find out how they determine that someone is dead before they begin carving out his organs."

They'd been searching for about an hour when Cathy came over to the carrel Peter was sitting in. "I've found something," she said.

He looked up expectantly.

She pulled up a chair and balanced a heavy volume on her lap. "This is a book on transplant procedures. The problem with transplants, it says, is that they never take the body off life support. If they did so, the organs would begin to deteriorate. So, even though the donors are *declared* dead, their hearts have never stopped. As far as the electrocardiogram is concerned, the supposedly-dead donor is as alive as you and me."

Peter nodded excitedly. This was exactly what he'd been hoping to find. "So how do they decide if the donor is dead?"

"One way is to squirt ice-cold water into his ears."

"You're kidding," he said.

"No. It says here that will completely disorient a person, even if they're in a deep coma. And it often causes spontaneous vomiting."

"Is that the only test?"

"No. They also rub the surface of the eyeball to see if the donor tries to blink. And they pull out the—what do you call it? That breathing tube?"

"The endotracheal ventilator."

"Yes," she said. "They pull that out for a short time to see if the body's need for oxygen will cause it to start breathing again on its own."

"What about EEGs?"

"Well, this is a British book. When it was written, their use for determining death wasn't required by law."

"Incredible," said Peter.

"But surely they have to use them here in North America, don't they?"

"I imagine so, in most jurisdictions."

"And this donor you saw today would have flatlined before they ordered his organs removed."

"Probably so," said Peter. "But in the course I took on EEGs, the prof

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talked about people who had completely flatlined subsequently showing some brain activity."

Cathy paled somewhat. "Still," she said, "even if the donor is still alive in some small sense . . . ."

He shook his head. "I'm not sure it's such a small sense. The heart is beating, the brain is receiving oxygenated blood, and there are signs that pain is being experienced."

"Even so," said Cathy, "even if all that's true, it must also be true that a brain that's shown no activity for an extended period must be severely damaged. You're talking about a vegetable."

"Probably," said Peter. "But there's a difference between harvesting organs from the dead, and ripping them from the bodies of the living, no matter how severely mentally handicapped that living person might be."

Cathy shivered and went back to searching. She soon found a three-year study of cardiac-arrest patients at Henry Ford Hospital in Detroit. One-quarter of the patients diagnosed as having no heartbeats did in fact still have them, as detected by catheters inserted into their bloodstreams. The report hinted that patients were being declared dead prematurely.

Meanwhile, Peter found several relevant London *Times* articles from 1986. Cardiologist David Wainwright Evans and three other senior doctors were refusing to do transplant operations there because of the ambiguity over when the donor is actually dead. They'd set out their concerns in a five-page letter to the British Conference of Royal Medical Colleges.

Peter showed the articles to Cathy. "But the Conference dismissed their concerns as unfounded," she said.

Peter shook his head. "I don't agree." He met her eyes. "It'll say in Enzo Bandello's obituary tomorrow that he died from head injuries sustained in a motorcycle accident. That's not true. I *saw* Enzo Bandello die. I was right there when it happened. He was killed by having his heart carved out of his chest."

CHAPTER 2
February 2011

Detective Sandra Philo continued to sift through Peter Hobson's memories.

After graduation, he had worked for several years at East York General Hospital, then had founded his own biomedical equipment company. In 1998, he and Cathy Churchill, still very much in love, had gotten married. Cathy had given up her interest in chemistry; Peter didn't yet understand why. Instead, she now worked in a non-creative position for Doo-wap Advertising.

And every Friday after work, Cathy and her coworkers went out for a drink. Actually, as Sandra discovered, although they referred to their intentions in the singular, the reality was decidedly plural: drinks. *And by the end of the evening, several of them always managed to successfully conjugate the verb form: drink, drank, drunk—often of the praying-to-the-porcelain-god variety . . . .*

It was cold and dark, a typical Feb-

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ruary evening in Toronto. Peter walked the seven blocks from the four-story Hobson Monitoring building to The Bent Bishop. Cathy's coworkers weren't really his sort, but he knew it was important to her that he make an appearance. Still, Peter always tried to arrive after everyone else; the last thing he wanted to do was make small talk with an account manager or an art director. There was something superficial about advertising that turned him right off.

Peter pushed open The Bishop's heavy wooden doors and stood in the entryway, his eyes adjusting to the dim interior. On his left was a blackboard with the daily specials printed on it. On his right was a poster for Molson's Canadian depicting a curvy woman in a red bikini with maple leaves crowning each of her upturned breasts. Sexism in beer advertising, thought Peter: past, present, probably forever.

He stepped out of the entryway and scanned the pub, looking for Cathy. Long gray tables at random angles were tightly packed throughout the room, like aircraft carriers in an oceanic traffic jam. In the background, two people were playing darts.

Ah, there they were: clustered around a table positioned against a wall. Those whose backs were to the wall—decorated with a poster of another Molson's bimbo—were seated on a couch. The rest were in captain's chairs, drinks in hand. Some were sharing a bowl of nachos. The table was big enough that two or three separate conversations were going on, the participants shouting to be heard above the blaring music, an old Mitsou tune played louder than the speakers could really handle.

Cathy was a very bright woman —that had been the first thing that had attracted Peter to her. It was only later that he redefined his own standards of feminine beauty, which had tended toward bouncy blondes *à la* the beer ads, to find her jet-black hair and thin lips beautiful. She was sitting on the long couch, two of her coworkers—Toby, was it? And that lout, Hans Larsen—on either side of her, so that she couldn't get out unless one of them moved first.

Cathy looked up as Peter approached, smiled her radiant smile, and waved. Peter still felt a thrill when she smiled. He wanted to sit next to her, but the current deployment of bodies made that impossible. Cathy smiled again, love plain on her face, then shrugged apologetically and gestured for him to take an unused chair from the adjacent table. Peter did so, and Cathy's coworkers shifted along to make room for him. He found himself sitting between one of the painted ladies on his left—the secretaries and production coordinators who wore too much makeup—and the pseudointellectual on his right. As always, Pseudo had a bookreader sitting in front of him, the cover of the datacard visible through the window in the reader's shell. Proust. Ostentatious bastard.

" 'Evening, Doc," said Pseudo.

Peter smiled. "How you doin'?"

Pseudo was about fifty, and slim as the Leafs's chances in the Stanley

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Cup. His fingernails were long, his hair dirty. Howard Hughes in training.

Others acknowledged Peter's presence, and Cathy gave him another special smile from across the table. His arrival had been enough to momentarily stop the separate conversations. Hans, on Cathy's right, seized the opportunity to grab everyone's attention. "The old ball-and-chain won't be home tonight," he announced generally. "Off to visit her nieces." That they were Hans's nieces, too, didn't seem to occur to him. "That means I'm free, ladies."

The women around the table groaned or giggled. They'd all heard this sort of thing from Hans before. He was hardly what you'd call a handsome man: he had dirty blond hair and looked something like the Pillsbury Doughboy. Still, his incredible boldness was appealing—even Peter, who found Hans's infidelity distasteful, had to admit that there was something inherently likable about the man.

One of the painted ladies looked up. Her crimson lipstick had been applied in a shape bigger than her actual lips. "Sorry, Hans. I've got to wash my hair tonight."

General laughter. Peter glanced at the pseudointellectual to see if the notion that cleaning one's hair might be a priority had registered on him. It hadn't. "Besides," said the woman, "a girl has to have her standards. I'm afraid you don't measure up."

Toby, on Cathy's left, chuckled. "Yeah," he said. "They don't call him *little* Hans for nothing."

Hans smiled from ear to ear. "As my daddy used to say, you can always go 'round the edges." He looked at the woman with the painted-on lips. "Besides, don't knock it until—until you've been knocked by me!" He roared, delighted at his own wit. "Ask Ann-Marie in accounting. She'll tell you how good I am."

"*Anna*-Marie," corrected Cathy.

"Details, details," said Hans, waving a mitten-like hand. "Anyway, if she won't vouch for me, ask that blonde temp in payroll—the one with the big casabas."

Peter was growing tired of this. "Why don't you try dating her instead?" he said, pointing at the woman in the Molson's poster. "If your wife comes home unexpectedly, you can fold her into a paper airplane and send her sailing out the window."

Hans roared again. He was good-natured, Peter would give him that. "Hey, the doc made a funny!" he said, looking from face to face, inviting them all to share in the supposed wonder of Peter having told a joke. Embarrassed, Peter looked away, and happened to catch the eye of the young man serving drinks. He raised his eyebrows at him, and he came over. Peter ordered a large orange juice; he didn't drink alcohol.

Hans wasn't one to let go, though. "Go ahead, Doc. Tell us another joke. You must hear lots of 'em in your line of work." He roared again.

"Well," said Peter, deciding to make an effort to fit in for Cathy's sake, "I was talking to a lawyer yesterday, and he told me a funny one." Two of the women had gone back to

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munching on nachos, evidently uninterested in his joke, but the rest of the group was looking at him expectantly. "See, there's this woman who killed her husband by hitting him over the head with a cruet of salad dressing." When the joke had been told to Peter, it had been about a husband killing his wife, but he couldn't resist reversing the roles in the hopes of planting the thought in Hans's head that Hans's wife might not approve of his philandering.

"Well," Peter continued, "the case finally comes to trial, and the crown attorney wants to introduce the murder weapon. She picks up the cruet off her desk. It still has a little glass stopper in its mouth, and is mostly full of liquid. She begins carrying it toward the judge. 'Your honor,' she says to the judge, 'this is the very item by which the deed was done. I'd like to enter it as Crown exhibit number one.' The lawyer holds it up to the light. 'As you can see, it's still full of oil and vinegar—' Well, at once, the defense attorney rises to his feet and pounds the table in front of him. 'I object, your honor!' he shouts. 'That evidence is immiscible!' "

They all stared at him. Peter grinned to show that the joke was over. Cathy did her best to laugh, even though she'd heard the joke the night before. "Immiscible," Peter said again, weakly. Still no general response. He looked at the pseudointellectual. Pseudo made a condescending little chuckle. He got it, or was pretending to have. But the other faces were blank. "Immiscible," said Peter. "It means they can't be mixed." He looked from face to face. "Oil and vinegar."

"Oh," said one of the painted ladies, and "ho ho" said another.

Peter's orange juice arrived. Hans pantomimed a bomb dropping, whistling a descending note as it fell, then making a sound like an explosion. When he looked up, he said, "Hey, everyone, did you hear about the whore who . . . ."

Peter suffered through another hour, although it seemed longer. Hans continued to hit on the women collectively and individually. Finally, Peter had had all he could take of him, of the noise, and of the lousy orange juice. He caught Cathy's eye and glanced meaningfully at his watch. She smiled a thank-you-for-your-indulgence smile just for him, and they got up to leave.

"Off so soon, Doc?" said Hans, speech noticeably slurred, his left arm now having taken up residence on the shoulders of one of the women.

Peter nodded.

"You should really let Cath stay out later."

The unfair remark angered Peter. He nodded curtly, she said her goodbyes, and they headed for the door.

It was only 7:30, but it was already black overhead, although the glare from the streetlights banished the stars. Cathy took Peter's arm, and they walked slowly along.

"I get pretty tired of him," said Peter, his words appearing as puffs of condensation.

"Who?" said Cathy.

"Hans."

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"Oh, he's harmless," said Cathy, snuggling closer to Peter as they walked.

"All bark and no bite?"

"Well, I wouldn't quite say that," she said. "He does seem to have dated just about everyone in the office."

Peter shook his head. "Don't they see through him? He's only after one thing."

She stopped, and reached up to kiss him. "Tonight, my love, so am I."

He smiled at her and she at him, and somehow it didn't seem cold outside anymore at all.

They'd made wondrous love, their naked forms mingling, each attentive to the other's desires. After thirteen years of marriage, seventeen of living together, and twenty-two since they'd first dated, they knew the rhythms of each other's bodies. And yet, after all that time, they still found new ways to surprise and please each other. Finally, after midnight, they had fallen asleep in each other's arms, calm, relaxed, spent, in love.

But about 3:00 A.M., Peter awoke with a start, sweating profusely. He'd had the dream again—the same dream that had been haunting him for eighteen years now.

Lying on an operating table, pronounced dead, but not. Scalpels and sternal saws cutting into him, his organs being removed from his torso.

Cathy, still naked, awoken by Peter's sudden movement, slipped out of bed, got him a glass of water, and sat, as she had on many nights before, holding him tight, until the terror had passed.

* * *

CHAPTER 3

Peter had seen the ads in magazines and on the net. "Live forever! Modern science can prevent your body from ever wearing out." He'd thought it was a scam until he saw an article about it in *Biotechnology Today*. A California company apparently could make you immortal for a fee of twenty million dollars. Peter didn't really believe it was possible, but the technology involved sounded fascinating. And, now that he was forty-two, the realization that he and Cathy were only going to have a few more decades together was the one thing in his life that made him sad.

Anyway, the California company —Life Unlimited—was putting on seminars around North America promoting their process. In due course, they came to Toronto, renting meeting space at The Royal York Hotel.

It was impossible to drive in downtown Toronto anymore; Peter and Cathy took the subway to Union Station, which connected directly with the hotel. The seminar was being held in the plush Ontario Room. About thirty people seemed to be in attendance, and—

"Uh oh," said Cathy softly to Peter.

Peter looked up. Colin Godoyo was approaching. He was the husband of Cathy's friend Naomi and a vice-president of the Toronto Dominion Bank—a rich guy who liked to show it off. Peter was quite fond of Naomi, but had never really thought much of Colin.

"Petey!" said Colin, loudly enough

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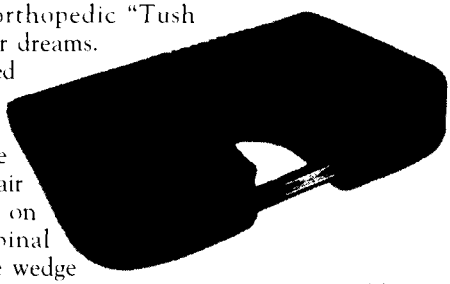

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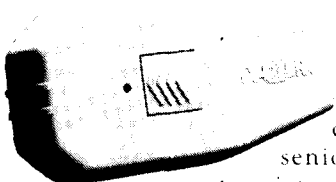

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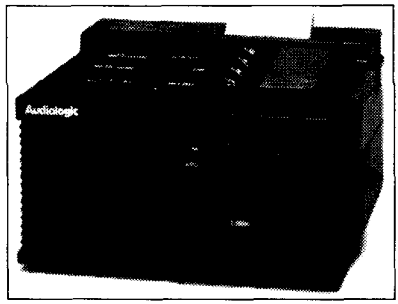

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so that every head in the room turned to look at them. He shoved a beefy hand toward Peter, who shook it. "And the gorgeous Catherine," he said, leaning in for a kiss, which Cathy reluctantly provided. "How wonderful to see the two of you!"

"Hi, Colin," said Peter. He jerked a thumb toward the front of the room where the presenter was setting up. "Thinking about living forever?"

"It sounds fascinating, doesn't it?" said Colin. "What about you two? The happy couple can't bear the thought of till death do us part?"

"I'm intrigued by the biomedical engineering," said Peter, somewhat put off by Colin's presumption.

"Of course," said Colin in an irritating, knowing tone. "Of course. And Cathy—want to keep those great looks of yours forever?"

Peter felt the need to defend his wife. "She has a degree in chemistry, Colin. We're both just intrigued by the science behind the process."

At that moment, the presenter spoke loudly from the front of the room. "Ladies and gentlemen—we're ready to begin. Please take your seats." Peter spotted two unoccupied chairs in an otherwise full row, and quickly steered him and Cathy toward them. Everyone settled in to listen to the sales pitch.

"Nanotechnology is the key to immortality," the fellow from Life Unlimited said to his audience. He was a muscular Afro-American, mid-forties, salt-and-pepper hair, with a wide smile. His suit looked like it cost two thousand bucks. "Our nanotechnology machines can prevent every aspect of aging." He indicated the picture on the wall screen: a blow-up of a microscopic robot. "Here's one now," he said. "We call them 'nannies,' because they look after you." He chuckled, and invited the audience to chuckle as well.

"Now, how do our nannies, which we distribute throughout your body, prevent you from growing old?" asked the man. "Simple. A large part of aging is controlled by timers on certain genes. Well, you can't eliminate the timers—they're necessary to the regulation of bodily processes—but our nannies read their settings and reset them as required. The nannies also compare the DNA your body is producing to images of your original DNA. If errors get introduced, the DNA is corrected at the atomic level. It's not much different from error-free computer communications, really. Checksums allow fast and accurate comparisons.

"The ravages caused by build-ups of toxic wastes in the body are also a major part of aging, but our nannies take care of all of that for you, cleaning the waste out.

"Autoimmune problems, such as rheumatoid arthritis, are another component of aging. Well, we've learned a lot about the autoimmune system in trying to cure AIDS, and we can now take care of almost anything that comes along.

"But the very worst part of aging is the loss of memory and cognitive functions. In many cases that's due simply to a lack of vitamin B_6 or B_{12}. It's also caused by not enough acetylcholine and other neurotransmitters.

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Again, our nannies balance all the levels for you.

"And what about Alzheimer's? It's genetically programmed to kick in at a certain age, although the onset can also be caused by high levels of aluminum. Our nannies get down and dirty with your genes, turning regulators on and off. We find the instruction for Alzheimer's, if it exists in your DNA—not everyone has it—and just prevent it from expressing itself."

The man smiled. "Now, I know what you're thinking. None of that is going to help me if I get shot in the chest by a mugger. Well, using patented Life Unlimited techniques, we can even make sure you live through that. Yes, the bullet will stop your heart—but our nannies monitor your blood oxygen levels and they themselves can deliver blood to the brain if need be, acting like tractors, pulling red blood cells. And, yes, you'll need a heart transplant and maybe some other repair work—but your brain will be kept alive until that work is done.

"OK—now you're thinking, hey, what if that mugger had shot me in the head instead?" The pitchman lifted up a thin sheet of what looked like silver foil. "This is polyester-D5. It's similar to Mylar." He held the sheet by one corner and let it flutter in the air. "Less than half a millimeter thick," he said, "but watch this." He proceeded to attach the sheet of foil to a square metal frame, anchoring it on all four sides. He then produced a gun with a silencer sticking off the front. "Don't worry," he said. "I've got a special permit for this." He chuckled. "I know how you Canadians feel about guns." He aimed the pistol at an angle and fired at the foil sheet. Peter heard the pistol bark and saw a lick of flame shoot out of its barrel. There was a sound like a thunderclap and something happened to the curtain behind the stage.

The pitchman went over to the metal frame and held up the mylar sheet. "No hole," he said—and indeed that was true. The sheet was rippling in the breeze of the air conditioner. "Polyester-D5 was developed for the military and is now widely used in bullet-proof vests by police forces all over the world. As you can see, it's quite flexible—unless it's hit at high speed. Then it tightens up and becomes harder than steel. That bullet I fired a moment ago bounced right off." He looked back. His assistant was coming on to the stage with something held in metal tongs. He dropped it into a little glass bowl on the podium. "Here it is."

The pitchman faced the audience. "We coat the skull with a thin, perforated layer of polyester-D5. Of course, we don't have to peel off the scalp to do that; we simply inject nanotechnology drones and have them lay it down. But with your skull protected by this stuff, you could take a bullet to the head, or have a car run over your cranium, or fall head first off a building, and still not crush your head. The polyester becomes so rigid, almost none of the percussion is transferred through to your brain."

He smiled brilliantly at his audience. "It's exactly as I said at the outset, folks. We can outfit you in such

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a way that you will not die—not through aging and not through almost any accident you can conceive of. For all intents and purposes, we offer exactly what we promise: honest-to-God immortality. Now, any takers?"

It was the first Sunday of the month. By long-standing tradition, that meant dinner with Peter's in-laws.

Cathy's parents lived on Bayview Avenue in North York. The Churchill house, a 1960s side-split with a one-car garage, would have once been considered good-sized but now was dwarfed by monster homes on either side, causing it to spend most of the day in shadow. Above the garage was a rusting basketball hoop with no net attached.

Cathy's thumbprint worked on the door lock. She went in first and Peter followed behind. Cathy shouted out, "We're here," and her mother appeared at the top of the stairs to greet them. Bunny Churchill—God help her, that was her name—was sixty-two, short, trim, with gray hair that she refused to dye. Peter liked her immensely. Cathy and he headed up into the living room. Peter had been coming here for years, but had still never quite gotten used to its appearance. There was only one small bookcase, and it held audio CDs and some video laser discs, including a complete run of Playboy Video Playmate Calendars since 1998.

Cathy's father taught phys ed. Gym teachers had been the bane of young Peter's existence, the first inkling he'd had that all adults weren't necessarily intelligent. Worse, Rod Churchill ran his family like a high school football team. Everything started on time—Bunny was rushing even now to get food on the table before the clock struck 6:00. Everybody knew their positions, and, of course, everyone followed the instructions of Coach Rod.

Rod sat at the head of the table, with Bunny at the opposite end and Cathy and Peter facing each other on either side—sometimes they played footsie when Ron got into one of his boring stories.

This was turkey month—the first-Sunday dinners rotated between turkey, roast beef, and chicken. Rod picked up the carving knife. He always served Peter first—"our guest first," he'd say, underscoring that even after thirteen years of marriage to his daughter, Peter was still an outsider. "I know what you want, Peter—a drumstick."

"Actually, I'd prefer white meat," said Peter politely.

"I thought you liked dark meat."

"I like dark *chicken* meat," said Peter, as he did every third month. "I like white turkey meat."

"Are you sure?" asked Rod.

No, I'm fucking making this up as I go along. "Yes."

Rod shrugged and carved into the breast. He was a vain man, a year from retirement, hair dyed brown—what was left of his hair, that is. He grew it long on the right side, and combed it over his bald pate. Dick Van Patten in a track suit.

"Cathy used to like drumsticks

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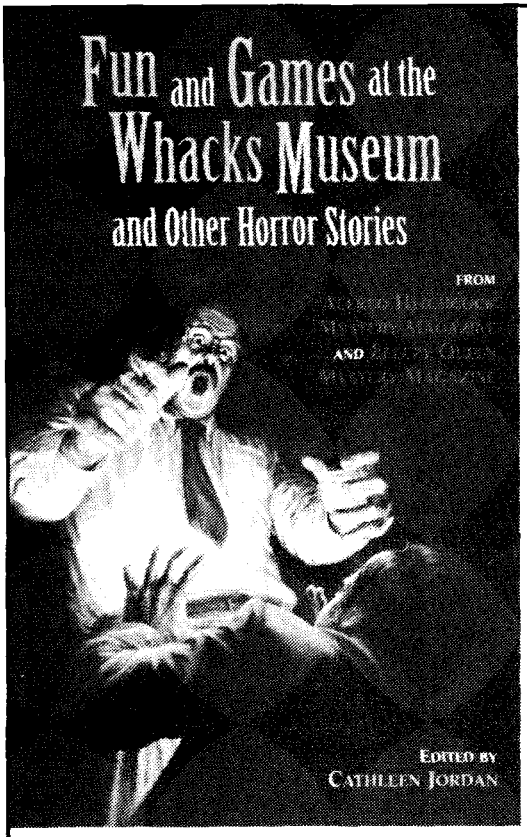

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when she was a little girl," Rod said.

"I still do," said Cathy, but Rod didn't seem to hear her.

"I used to like giving her a big drumstick and watch her try to get a bite out of it."

"She could have choked to death," said Bunny.

Rod grunted. "Kids can take care of themselves," he said. "I remember that time she fell down the stairs." He laughed, as if life should be one big slapstick comedy. He glanced at Bunny. "You were more upset than Cathy was. She waited until a big enough audience had arrived before she started crying." He shook his head. "Kids got bones made out of rubber." Rod handed Peter a plate with two ragged slices of turkey breast on it. Peter took it and reached for the bowl of baked potatoes. Friday evenings at The Bent Bishop somehow didn't seem that bad right now.

"I was bruised for weeks," said Cathy, a bit defensively.

Rod chuckled. "On her bum."

Peter still had a long scar on his leg from a high-school gym accident. Those darned phys ed teachers. Such funny guys. He waited until everyone was served, helped himself to the gravy boat, then passed it to Rod.

"No thanks," said Rod. "I'm not eating much gravy these days."

Peter thought about asking why, decided against it, and passed the gravy boat to Cathy instead. He turned to his mother-in-law and smiled. "Anything new with you, Bunny?"

"Oh, yes," she said. "I'm taking a course Wednesday nights—conversational French. I figure it's about time I learned."

Peter was impressed. "Good for you," he said. He turned to Rod. "Does that mean you have to fend for yourself Wednesday evenings?"

Rod grunted. "I order in from Food Food," he said.

Peter chuckled.

Cathy said to her mother, "The turkey is delicious."

"Thank you, dear," said Bunny. She smiled. "I remember that time you played a turkey in the Thanksgiving play at school."

Peter raised an eyebrow. "I didn't know about that, Cathy." He looked at his father-in-law. "How was she, Rod?"

"I don't know. I didn't go. Watching children dressed up as livestock isn't my idea of a fun evening."

"But she's your daughter," said Peter, then wished he hadn't.

Rod helped himself to some cooked carrots. Peter suspected he would have gone to watch a son play in Little League.

"Dad never took much interest in children," said Cathy, her tone neutral.

Rod nodded, as if this was a perfectly reasonable attitude for a father to take. Peter stroked Cathy's leg gently with his foot.

CHAPTER 4
August 2011

The world goes through two seasons in six months. Should it be surprising that other things change a lot in that time, too?

Peter had downloaded this week's

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Time from the net and was glancing through it. World News. People. Milestones.

Milestones.

Births, marriages, divorces, deaths.

Not all milestones were so cut-and-dried. Where were things such as the disintegration of a romance noted? What was the journal-of-record for lingering malaise, for empty hearts? Who marked the death of happiness?

Peter remembered how Saturday afternoons used to be. Lazy. Loving. Reading the paper together. Watching a little TV. Drifting at some point to the bedroom.

Milestones.

Cathy came down the stairs. Peter looked up briefly. There was hope in lifting his eyes, hope that he'd see the old Cathy, the Cathy he'd fallen in love with. His eyes fell back to the text reader. He sighed—not theatrically, not for her ears, but for himself, a heavy exhalation, trying to force the sadness from his body.

Peter had inventoried her appearance in that quick glance. She was wearing a ratty U of T sweatshirt and loose-fitting jeans. No make-up. Hair quickly combed but not brushed, falling in black bunches around her shoulders. Glasses instead of contacts.

Another small sigh. She looked so much better without the thick lenses balancing on her nose, but he couldn't remember the last time she'd worn her contacts.

They hadn't made love for six weeks.

The national average was 2.1 times each week. Said so right here in *Time*.

Of course, *Time* was an American magazine. Maybe the average was different here in Canada.

Maybe.

This year would be their thirteenth wedding anniversary.

And they hadn't made love in six fucking weeks. Six *fuckless* weeks.

He glanced up again. There she stood, on the third stair up, dressed like some goddamn tomboy.

She was forty-one now; her birthday had been last month. She still had her figure—not that Peter saw it much anymore. These sweatshirts and too-big sweaters and long skirts—these *bags* she'd taken to wearing—hid just about everything.

Peter stabbed the PgDn button. He tipped his head down, went back down to his reading. They used to make love a lot on Saturday afternoons. But, Christ, if she was going to dress like that . . . .

He'd read the first three paragraphs of the article in front of him, and realized that he hadn't a clue as to what it had said, hadn't absorbed a single word.

He glanced up once more. Cathy was still on the third step, looking down at him. She met his eyes for an instant, but then dropped her gaze, and, hand on the wooden banister, stepped down into the living room.

Focussing on the magazine, Peter said, "What would you like for dinner?"

"I don't know," she said.

I don't know. The national anthem of Cathyland. Christ, he was sick of hearing that. What would you like to do tonight? What would you like for

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dinner? Want to take a vacation?

I don't know.

I don't know.

I don't know.

Fuck it.

"I'd like fish, myself," said Peter, and again he stabbed the PgDn button.

"Whatever would make you happy," she said.

It would make me happy if you'd talk to me, thought Peter. *It would make me happy if you'd didn't fucking dress down all the time.*

"Maybe we should just order in," said Peter. "Maybe a pizza, or some Chinese."

"Whatever."

He turned the pages again, new words filling his screen.

Thirteen years of marriage.

"Maybe I'll give Sarkar a call," he said, testing the waters. "Go out and grab a bite with him."

"If you like."

Peter shut the reader off. "Dammit, it's not just what *I'd* like. What would you like?"

"I don't know."

It had been building for weeks, he knew, festering within him, pressure increasing, an explosion imminent, his sighs never releasing enough of what was pent up, what was ready to blow. "Maybe I should go out with Sarkar and not come back."

She stood motionless across the room from him. The staircase rose up behind her. It looked as though her lower lip was trembling a little. Her voice was small. "If that would make you happy."

It's falling apart, thought Peter. *It's falling apart right now.*

Peter turned the magazine reader back on but immediately flicked it off again. "It's over, isn't it?" he said.

Thirteen years . . . .

He should get up from the couch now, get up and leave.

Thirteen years . . . .

"Jesus Christ," said Peter, into the silence.

"Peter . . . ."

Eyes still closed.

"Peter," said Cathy. "I slept with Hans Larsen."

He looked at her, mouth open, heart pounding. She didn't meet his gaze.

Cathy moved hesitantly into the center of the living room. There was quiet between them for several minutes. Peter's stomach hurt. At last, his voice raspy, raw, as though the wind had been knocked out of him, said, "I want to know the details."

Cathy spoke softly. She didn't look at him. "Does it matter?"

"Yes, it matters. *Of course* it matters. How long has this . . ." he paused ". . . this *affair* been going on?" Christ, he'd never expected to use that word in this context.

Her lower lip was trembling again. She took a step toward him, as if she meant to sit beside him on the couch, but she hesitated when she saw the expression on his face. Instead, she moved slowly to take a chair. She sat down, weary, as if the tiny walk down to the living room had been the longest of her life. She carefully placed her hands in her lap and looked down at them. "It wasn't an affair," she said softly.

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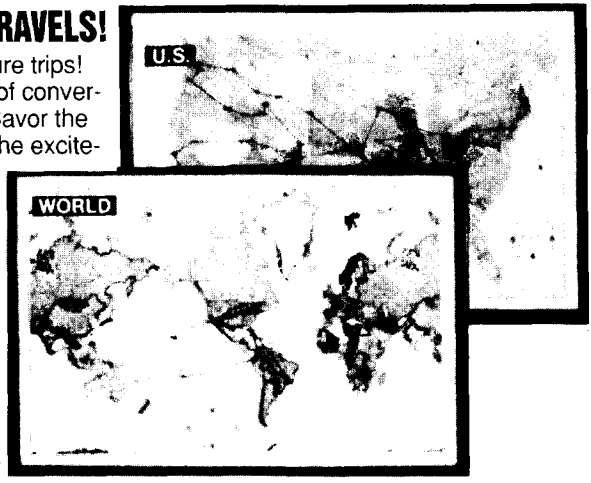

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"What the hell would you call it?" said Peter. The words were angry, but his tone wasn't. It was drained, lifeless.

"It was . . . it *wasn't* a relationship," she said. "Not really. It just happened."

"How?"

"A Friday night, after work. You didn't come that time. Hans asked me for a lift to the subway. We went back to the company parking lot together and got my car. The lot was deserted by then, and it was pretty dark."

Peter shook his head. "In your car?" he said. He paused for a long time, then said, softly, "You"—and the next word came slowly, unbidden, released from his lips with a little shrug as if there were no other word that would quite do—"slut."

Her face was puffy, and her eyes were red, but she wasn't crying. She moved her head back and forth slightly as though trying to deny the word, a word that no one had ever applied to her before, but then at last she also shrugged, perhaps accepting the term.

"What happened?" said Peter. "Exactly what did you do?"

"We had sex. That was all."

"What kind of sex?"

"Normal sex. He just dropped his pants and lifted my skirt. He—he didn't touch me anywhere."

"But you were wet anyway?"

She bristled. "I . . . I'd had too much to drink."

Peter nodded. "You never used to drink. Not before you started working with them."

"I know. I'll stop."

"What else happened?"

"Nothing."

"Did he kiss you?"

"Before, yes. Not after."

Sarcastic: "Did he tell you he loved you?"

"Hans says that to everyone."

"Did he say it to you?"

"Yes, but . . . but it was just words."

"Did you say it to him?"

"Of course not."

"Did you—did you come?"

A whisper. "No." And then a tear did roll down her cheek. "He—he asked me if I had come. As if anyone would have, in and out like that. He asked me. I said no. And he laughed. Laughed, and pulled up his trousers."

"When did this happen?"

"You remember that Friday I came home late and had a shower?"

"No. Wait—yes. You never have a shower in the evening. But that was *months* ago—"

"February," said Cathy.

Peter nodded. Somehow, the fact that this had happened so long ago made it more bearable. "Six months ago," he said.

"Yes," she said, and then, the words like a trio of bullets tearing into his heart, "The first time."

All the stupid questions welled up in his brain. You mean there were others? Yes, Peter, that's exactly what she means. "How many times?"

"Two more."

"For a total of three."

"Yes."

Sarcastic again: "But 'affair' is the wrong word for this?"

Cathy was silent.

"Jesus Christ," said Peter softly.

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"It wasn't an affair."

Peter nodded. He knew what kind of person Hans was. Of course it hadn't been an affair. Of course there was no love involved. "Just sex," said Peter.

Cathy, wisely, said nothing.

"Christ," said Peter again. He still had the magazine reader in his hand. He looked at it, thinking he should throw it across the room, smash it against a wall. After a moment, he simply dropped it on the couch next to him. It bounced silently against the cushion. "When was the last time?" he said.

"Three months ago," she said, her voice small. "I've been trying to work up the courage to tell you. I—I didn't think I could. I tried twice before, but I just couldn't do it."

Peter said nothing. There was no appropriate reaction, no way to deal with it. Nothing. An abyss.

"I—I thought about killing myself," Cathy said after a very long pause, her voice attenuated like a pre-dawn wind. "Not poison or slitting my wrists, though—nothing that would look like suicide." She met his eyes briefly. "A car accident. I was going to ram into a wall. That way, you'd still love me. You'd never know what I'd done, and . . . and you'd remember me with love. I tried. I was all ready to do that, but, when it finally came down to it, I swerved the car." Tears were running down her cheeks. "I'm a coward," she said at last.

Silence. Peter tried to make sense of it all. There was no point in asking if she was going to go with Hans. Hans didn't want a relationship, not a *real* relationship, not with Cathy or any woman. Hans. Fucking Hans.

"How could you get involved with Hans, Hans of all people?" asked Peter. "You know what he is."

She looked at the ceiling. "I know," she said softly. "I know."

"I've always tried to be a good husband," said Peter. "You know that. I've been supportive in every way possible. We talk about everything. There's no communication problem, no way you can say I don't listen to you."

Her voice took on an edge for the first time. "Did you know I've been crying myself to sleep for months?"

They had a pair of bedside fans that they used as white-noise generators, drowning out the sounds of traffic from outside, as well as each other's occasional snoring. "There's no way I could have known that," he said. He'd occasionally noticed her shuddering next to him as he fell to sleep. Half conscious, he'd idly thought she'd been masturbating; he kept that thought to himself.

"I've got to think about this," he said slowly. "I'm not sure what I want to do."

She nodded.

Peter threw his head back, let out a long, ragged sigh. "Christ, I have to rewrite the entire last six months in my mind. That vacation we took in New Orleans. That was after you and Hans— And that time we borrowed Sarkar's cottage for the weekend. That was after, too. It's all different now. All of it. Every mental picture from that time, every happy moment—fake, tainted."

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"I'm sorry," said Cathy, very softly.

"Sorry?" Peter's voice was ice. "You might have been sorry if it happened just once. But three times? Three fucking times?"

Her lips were trembling. "I *am* sorry."

Peter sighed again. "I'm going to call Sarkar and see if he's free for dinner."

Cathy was silent.

"I don't want you along. I want to talk to him alone. I've got to sort things out."

She nodded.

CHAPTER 5

Peter had known Sarkar Muhammed since they'd both been teenagers. They'd lived on the same street, although Sarkar had gone to a private school. They had perhaps seemed unlikely prospects for friendship. Sarkar was heavily involved in athletics. Peter was on his school's yearbook and newspaper staffs. Sarkar was devoutly Muslim. Peter wasn't devoutly anything. But they'd hit it off shortly after Sarkar's family moved into the neighborhood. Their senses of humor were similar, they both liked to read Agatha Christie, and they were both experts at Star Trek trivia. Also, of course, Peter didn't drink and that made Sarkar happy. Although Sarkar would eat in licensed restaurants, whenever possible he avoided sitting at a table with someone who was imbibing alcohol.

Sarkar had gone to the University of Waterloo to study computer science. Peter had studied biomedical engineering at U of T. They'd kept in touch all through university, swapping e-mail letters over the Internet. After a brief stint in Vancouver, Sarkar had ended up back in Toronto, running his own high-tech startup firm doing expert-systems design. Although Sarkar was married and had three children, Peter and he often dined out together, just the two of them.

Incongruously, dinner was always at Sonny Gotlieb's, a deli at Bathurst and Lawrence, in the heart of Toronto's Jewish district. Peter couldn't stand Pakistani cuisine, despite Sarkar's valiant efforts to broaden his palate, and Sarkar had to eat where he could get food that adhered to Islamic dietary laws, something which most Kosher fare managed to do admirably. And so the two of them sat in their usual booth, surrounded by *zaydes* and *bubbehs* chatting away in Yiddish, Hebrew, and Russian.

After they had ordered, Sarkar asked Peter what was new. "Not much," said Peter, his tone guarded. "What about you?"

Sarkar spoke for a couple of minutes about a contract his company had received to do expert-systems for the New Democratic Party of Ontario. They'd only been in power once, in the early 1990s, but were always hoping to make a comeback. Before Canadian socialist governments disappeared completely from living memory, they wanted to capture the knowledge of party members who had actually been in power back then.

Peter half-listened to this. Ordinarily, he found Sarkar's work fasci-

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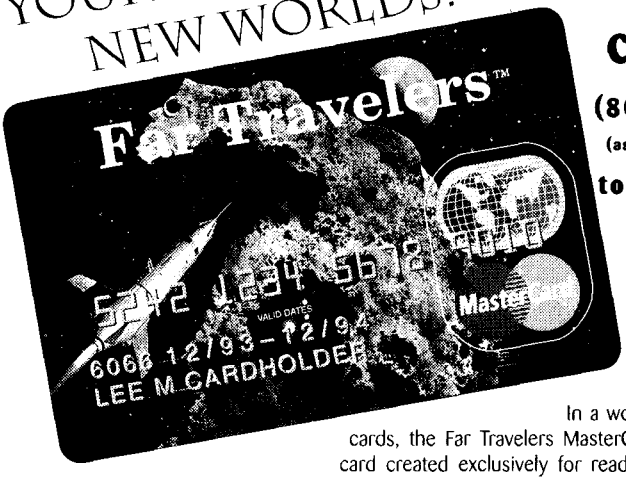

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nating, but tonight his mind was a million kilometers away. The waiter returned with a pitcher of Diet Coke for them, and a basket of assorted bagels.

Peter wanted to tell Sarkar about what had happened with Cathy. He opened his mouth a couple of times to say something, but always lost his nerve before the words got out. What would Sarkar think of him if he knew? What would he think of Cathy? He thought at first that he wasn't telling Sarkar because of his religion; Sarkar's family was prominent in the Toronto Muslim community and Peter knew that they still practiced arranged marriages. But that wasn't it. He simply couldn't bring himself to speak aloud to anyone—*anyone*—about what had happened.

Although he wasn't really hungry, Peter took a poppy-seed bagel from the basket and spread a little cream cheese on it.

"How is Catherine?" Sarkar asked, helping himself to a rye bagel.

Peter took advantage of having his mouth full to buy a few seconds to think. Finally, he said, "Fine. She's fine."

Sarkar nodded, accepting that.

A little later Sarkar asked, "How's the second weekend in September sound for our trip up north?"

For six years now, Peter and Sarkar had been going away for a weekend of camping in the Kawarthas. "I—I'll have to get back to you about that," said Peter.

Sarkar helped himself to another bagel. "OK."

Peter loved these camping weekends. He wasn't much of an outdoors person, but he enjoyed seeing the stars. He'd never really agreed to an annual excursion, but with Sarkar anything done twice instantly became an inviolable tradition.

Getting away would be good, thought Peter. Very good.

But—

He couldn't go.

Not this year. Maybe not ever.

He couldn't leave Cathy alone.

He couldn't, because he couldn't be sure that she would in fact be alone.

Dammit. God damn it.

"I'll have to get back to you," Peter said again.

Sarkar smiled. "You said that."

Peter realized the whole evening would be a disaster if he didn't get his mind on something else. "How's that new brain scanner my company built for you working out?" Peter asked.

"Great. It's going to really simplify our neural-net studies. Wonderful machine."

"Glad to hear it," said Peter. "I've been working on refining it, trying to get a higher level of resolution."

"The current resolution is more than adequate for the kind of work I do," said Sarkar. "Why would you want more?"

"Remember when I was doing my practicum at U of T? I told you about that transplant donor who woke up on the operating table?"

"Oh, yes." Sarkar shivered. "You know my religion is suspicious of transplants. We feel the body should be returned to the Earth whole. Sto-

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ries like that make me believe that even more."

"Well, I still have nightmares about it. But I think I'm finally going to be able to put that demon to rest."

"Oh?"

"That scanner we developed for your work was just a first-stage unit. I really wanted to develop a—a superEEG, if you will, that can detect *any* electrical activity at all in the brain."

"Ah," said Sarkar, his eyebrows lifting, "so you can tell when someone is really dead?"

"Precisely."

The server arrived with their main course. Peter had a stack of Montreal smoked meat and rye bread, accompanied by a little carousel rack of various mustards and a side order of latkes—what Sarkar referred to as Peter's heart-attack kit. Sarkar had gefilte fish.

"That's right," said Peter. "I've been poking at this for years now, but I've finally had the breakthrough I needed. Signal-to-noise-ratio problems were killing me, but while scanning the net I found some algorithms created for radio astronomy that finally let me solve the problem. I've now got a working prototype superEEG."

Sarkar put down his fork. "So you can see the last neural gasp, so to speak?"

"Exactly. You know how a standard EEG works: each of the brain's billions of neurons is constantly receiving excitatory synaptic input, inhibitory input, or a combination of the two, right? The result is a constantly fluctuating membrane potential for each neuron. EEGs measure that potential."

Sarkar nodded.

"But in a standard EEG, the sensor wires are much bigger in diameter than individual neurons. So, rather than measuring the membrane potential of any one neuron, they measure the combined potential for all the neurons in the part of the brain beneath the wire."

"Right," said Sarkar.

"Well, that coarseness is the source of the problem. If only one neuron, or a few dozen or even a few hundred are reacting to synaptic input, the voltage will be orders of magnitude below what an EEG can read. Even though the EEG shows a flat line, brain activity—and therefore life—may still be continuing."

"A crisp problem," said Sarkar. "Crisp" was his favorite word; he used it to mean anything from well-defined to delicate to appealing to complex. "So you say you've found the solution?"

"Yes," said Peter. "Instead of the small number of wires used by a standard EEG, my superEEG uses over one billion nanotech sensors. Each sensor is as tiny as an individual neuron. The sensors blanket the skull, like a bathing cap. Unlike a standard EEG, which picks up the combined signal of all the neurons in a given area, these sensors are highly directional and pick up only the membrane potential from neurons directly beneath them." Peter held up a hand. "Of course, a straight line drawn through the brain will intersect thou-

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sands of neurons, but by cross referencing the signals from all the sensors, I can isolate the individual electrical activity of each and every neuron in the entire brain."

Sarkar ate another fish ball. "I see why you were having signal-to-noise problems."

"Exactly. But I've solved that now. With this equipment, I should be able to detect any electrical activity at all in the brain, even if it's just one lone neuron firing."

Sarkar looked impressed. "Have you tried it yet?"

Peter sighed. "On animals, yes. A few large dogs—I haven't been able to make the scanning equipment small enough to use on a rat or rabbit yet."

"So does this superEEG actually do what you want? Does it show the exact, crisp moment of actual death—the ultimate cessation of brain electrical activity?"

Peter sighed. "I don't know. I've got gigabytes of recordings of Labrador retriever brain waves now, but I can't get a permit to put any of them to sleep." He spread some more mustard on his meat. "The only way to test it properly will be with a dying human being."

CHAPTER 6

Peter knocked, then quietly entered the private room in the chronic-care facility. A frail woman about ninety years old was sitting up, the bed's back raised to a forty-five degree angle. Two IV bags of clear liquid hung on poles beside her bed. A tiny TV was mounted on a swing arm at the bed's right.

"Hello, Mrs. Fennell," Peter said softly.

"Hello, young man," said the woman, her voice thin and hoarse. "Are you a doctor?"

"No, at least, not a medical doctor. I'm an engineer."

"Where's your train?"

"Not that kind of engineer. I'm—"

"I was kidding, son."

"Sorry. Dr. Chong said you had a good attitude."

She shrugged amiably, the movement of her shoulders taking in the hospital room, the drip bags, and more. "I try."

Peter looked around. No flowers. No get-well cards. It seemed Mrs. Fennell was all alone in the world. He wondered how she could be so cheerful. "I, ah, have a favor to ask you," he said. "I need your help with an experiment."

Her voice was like dry leaves crumbling. "What kind of experiment?"

"It won't hurt at all. I'd simply like you to wear a special piece of headgear that has a series of tiny electrodes in it."

Leaves crumbled in a way that might have been a chuckle. Mrs. Fennell indicated the tubes going into her arm. "A couple more connections won't hurt, I guess. How long do you want me to wear this?"

"Until, ah, until—"

"Until I die, is that it?"

Peter felt his cheeks grow flush. "Yes, ma'am."

"What are the electrodes for?"

"My company makes biomedical monitoring equipment. We've devel-

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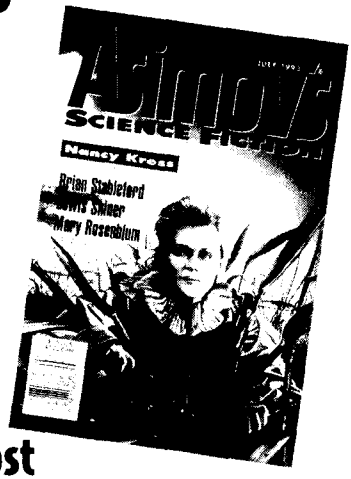

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oped a prototype for a new hypersensitive electroencephalogram. Do you know what an EEG is?"

"A brain-wave monitor." Mrs. Fennell's face seemed to be immobile; Chong had said she'd suffered a series of small strokes. But her eyes smiled. "You don't spend as much time in hospitals as I have without picking up something."

Peter chuckled. "This special brain-wave monitor is a lot more discerning than the standard one they've got here. I'd like to record, well . . . ."

"You'd like to record my death, is that it?"

"I'm sorry. I don't mean to be insensitive."

"You're not. Why do you want to record my death?"

"Well, you see, right now, there's no one-hundred-percent accurate way of determining when the brain has permanently ceased to function. This new device should be able to indicate the exact moment of death."

"Why should anyone care about that? I have no relatives."

"Well, in many cases bodies are kept on life support simply because we don't know whether the person is really dead or not. I'm trying to come up with a definition for death that isn't just legal but is *actual*—an unequivocal test that can prove whether someone is dead or alive."

"And how will this help people?" she said. Her tone made it clear that to her this was what mattered most.

"It'll help with organ transplants," Peter said.

She cocked her head. "No one would want my organs."

Peter smiled. "Perhaps not, but someday my equipment may ensure that we don't accidentally take organs from people who aren't yet truly dead. It'll also be useful in emergency rooms and at accident scenes, to make sure attempts to save a patient aren't halted too soon."

Mrs. Fennell digested this for a moment, then: "You don't really need my permission, do you? You could have just had the equipment hooked up. Just say it was for routine tests. Half the time they don't explain what they're doing anyway."

Peter nodded. "I suppose that's true. But I thought it would be polite to ask."

Mrs. Fennell's eyes smiled again. "You're a very nice young man, Doctor . . . ?"

"Hobson. But, please, call me Peter."

"Peter." Her eyes crinkled. "I've been here for months, and not one of the doctors has volunteered that I could call them by their first name. They've prodded every part of my body, but they still think keeping emotional distance is part of their job." She paused. "I like you, Peter."

Peter smiled. "And I like you, Mrs. Fennell."

She did manage an unequivocal laugh this time. "Call me Peggy." She paused, and reflection further creased her wrinkled face. "You know, that's the only time I've heard my own first name since I was admitted here. So, Peter, are you really interested in what happens at the moment of death?"

"Yes, Peggy, I am."

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"Then why don't you have a seat, make yourself comfortable, and I'll tell you." She lowered her voice. "You see, I've already died once before."

"I beg your pardon?" She had seemed so lucid . . . .

"Don't look at me like that, Peter. I'm not insane. Sit down. Go ahead, sit. I'll tell you what happened." Peter cocked his head slightly, noncommittal, and found a vinyl-covered chair. He pulled it close to the bed.

"It happened forty years ago," said Mrs. Fennell, turning her crab-apple head to face Peter. "I'd recently been diagnosed with diabetes. I was insulin-dependent, but hadn't yet realized how careful I had to be. My husband Kevin had gone shopping. I'd had my morning insulin injection, but hadn't eaten yet. The phone rang. It was a woman I knew who nattered on endlessly, or so it seemed. I found myself sweating and getting a headache, but I didn't want to say anything. I realized my heart was pounding and my arm was trembling and my vision was blurring. I was about to say something to the woman, to beg off and go get something to eat when, all of a sudden, I collapsed. I was having an insulin reaction. Hypoglycemia."

Although her face was impassive, deadened by strokes, her voice became increasingly animated. "Suddenly," she said, "I found myself *outside* of my body. I could see myself as if from above, lying there on the kitchen floor. I kept rising higher and higher until everything sort of collapsed into a tunnel, a long, spiralling tunnel. And at the end of this tunnel, there was a beautiful, pure, bright white light. It was very bright, but it didn't hurt at all to look at it. This feeling of calm, of peace, came over me. It was absolutely wonderful, an unconditional acceptance, a feeling of love. I found myself moving toward the light."

Peter tilted his head. He didn't know what to say. Mrs. Fennell went on. "From out of the edges of the light a figure appeared. I didn't recognize it at first, but then suddenly I saw that it was me. Except it wasn't me; it was someone who looked a lot like me, but *wasn't* me. I'd been born a twin, but my twin sister Mary had died a few days after we were born. I realized that *this* was Mary, come to greet me. She floated closer and took my hand, and we drifted down the tunnel together, toward that light.

"And then I started seeing images from my life, as though they were on movie film, pictures of me and my parents, me and my husband, me at work, at play. And Mary and I were reviewing each of these scenes, where I'd done right and where I'd done wrong. There was no sense that I was being judged, but it seemed important that I understand everything, realize the effect my actions had on others. I saw myself playing in a schoolyard, and cheating on an exam, and working as a candy striper in a hospital, and oh so many other things, vividly, with unbelievable clarity. And all the while we were growing closer to that beautiful, beautiful light.

"Then, suddenly, it was over. I felt myself being pulled backward and

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downward. I didn't want to let go of Mary's hand—I'd lost her once, after all, had never really had the chance to know her—but my fingers slipped from hers and I drifted backward, away from the light, and then, suddenly, I was back in my body. I could tell there were other people there. Soon my eyes opened, and I saw a man in a uniform. A paramedic. He had a syringe in his hand. He'd given me an injection of glucagon. 'You're going to be all right,' he was saying. 'Everything's going to be all right.'

"The woman I'd been talking to on the phone—her name was Mary, by coincidence—had finally realized that I'd fainted and had hung up and called for an ambulance. The paramedics had had to break down my front door. If they'd arrived a few minutes later, I'd have been gone for good.

"So, Peter, I know what death is like. And I don't fear it. It changed my whole attitude toward life, that experience. I learned to see everything with perspective, take everything in stride. And although I know I've only got a few days left now, I'm not afraid. I know my Kevin will be waiting for me in that light. And Mary, too."

Peter had listened intently to the whole thing. He'd heard of such stories before, of course, and had even read part of Moody's famous book *Life After Life,* when he'd been trapped at a relative's cottage and the choice was that or a book on how sun signs supposedly affected your love life. He didn't know what to make of such stories then, and was even more uncertain now.

"Did you tell any of your doctors here about this?" Peter asked.

Peggy Fennell snorted. "Those guys come through here like they're marathon runners and my chart is the baton. Why in God's name would I share my most intimate experiences with them?"

Peter nodded.

"Anyway," said Mrs. Fennell. "That's what death's like, Peter."

"I—ah, I'd—"

"You'd still like to do your experiment, though, wouldn't you?"

"Well, yes."

Mrs. Fennell moved her head slightly, the closest thing to a nod she could manage. "Very well," she said at last. "I trust you, Peter. You seem a good man, and I thank you for listening to me. Go get your equipment."

It had been one hell of a week since Cathy had made her announcement. They weren't talking much, and when they did talk, it was about things such as Peter's experiment with the super-EEG. Nothing personal, nothing directly related to them. Just safe topics to fill some of the long, melancholy silences.

Now, on Saturday afternoon, Peter sat on the living-room couch, reading. No electronic book this time, though: instead he was reading an honest-to-goodness paperback.

Peter had only recently discovered Robert B. Parker's old *Spenser* novels. There was something appealing about the absolute, unequivocal trust shared by Spenser and Hawk, and a wonderful

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honesty in the relationship between Spenser and Susan Silverman. Parker had never given Spenser a first name, but Peter thought his own—meaning "rock"—would have been a fine choice. Certainly, Spenser was more rock-stable than Peter Hobson was.

On the wall behind him was a framed print of an Alex Colville painting. Peter had originally thought Colville static, but, over the years, his work had grown on him, and he found this particular painting—a man sitting on a cottage porch, an old hound dog lying at his feet—very appealing. Peter had finally realized that the lack of movement in Colville's art was designed to convey permanence: these are the things that last, these are the things that matter.

Peter still didn't know what to make of it all, didn't know what future he and Cathy might have. He realized he'd just read a funny scene—Spenser deflecting Quirk's questions with a series of vintage quips, Hawk standing motionless nearby, a grin splitting his features—but it hadn't amused Peter the way it should have. He slipped a bookmark into the paperback and set it down beside him.

Cathy came down the stairs. She was wearing her hair down and was dressed in snug blue jeans and a loose-fitting white blouse with the top two buttons undone—attire, Peter realized, that could be viewed as either sexy or neutrally practical. She clearly was as confused as Peter, carefully trying to send signals that hopefully would be correct regardless of what mood he was in. "May I join you?" she said, her voice a feather fluttering in a breeze.

Peter nodded.

The couch consisted of three large cushions. Peter was sitting on the leftmost. Cathy sat on the border between the middle one and rightmost, again trying for both closeness and distance simultaneously.

They sat together for a long time, saying nothing.

Peter kept moving his head slowly back and forth. He felt warm. His eyes weren't focussing properly. Not enough sleep, he guessed. But then, suddenly, he realized that he was about to start crying. He took a deep breath, trying to forestall it. He remembered the last time he'd really cried: he'd been twelve years old. He'd been ashamed then, thinking he was too old to cry, but he'd had a frightening shock from an electrical outlet. In the thirty intervening years, he'd maintained his stoic face no matter what, but now, welling up within him . . . .

He had to leave, get somewhere private, away from Cathy, away from everyone . . . .

But it was too late. His body convulsed. His cheeks were wet. He found himself shuddering again and again. Cathy raised a hand from her lap, as if to touch him, but apparently thought better. Peter cried for several minutes. One fat drop fell on the edge of the Spenser paperback and was slowly absorbed into the newsprint.

Peter wanted to stop, but couldn't. It just came and came. His nose was running now; he snorted between the shuddering convulsions that brought out the tears. It had been too much,

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held in too long. Finally, he was able to force out a few feeble, quiet words. "You've hurt me," was all he said.

Cathy was biting her lower lip. She nodded slightly, her eyes batting up and down, holding in her own tears. "I know."

CHAPTER 7

"Hello," said the slim black woman. "Welcome to the Family Service Association. I'm Danita Crewson. Do you prefer Catherine or Cathy?" She had short hair and was dressed in a beige jacket and matching skirt, and wore a couple of pieces of simple gold jewelry—the perfect image of a modern professional woman.

Still, Cathy was slightly taken aback. Danita Crewson looked to be all of twenty-four. Cathy had expected the counselor to be old and infinitely wise, not someone fifteen years her junior. "Cathy is fine. Thank you for squeezing me in on such short notice."

"No problem, Cathy. Did you fill out the needs assessment?"

Cathy handed her the clipboard. "Yes. Money is no problem; I can pay the full fee."

Danita smiled as if this was something she heard all too infrequently. "Wonderful." When she smiled, no wrinkles appeared at the corners of her eyes. Cathy was envious. "Now, what seems to be the problem?"

Cathy tried to compose herself. She'd been tortured for months by what she'd done. *God,* she thought. *How could I have been so stupid?* But, somehow, it wasn't until she actually saw Peter cry that she realized she had to do something to get help. She couldn't bear to hurt him like that again. Cathy folded her hands on her lap and said, very slowly, "I, ah, cheated on my husband."

"I see," said Danita, her tone one of professional detachment, free of any judgment. "Does he know?"

"Yes. I told him." Cathy sighed. "It was the most difficult thing I've ever done."

"How did he take it?"

"He was devastated. I've never seen him so shaken."

"Did he get angry?"

"He was furious. But he was also very sad."

"Did he hit you?"

"What? No. No, he's not an abusive husband—not at all."

"Neither physically nor verbally?"

"That's right. He's always been very good to me."

"But you cheated on him."

"Yes."

"Why?"

"I don't know."

"Now that you've told your husband," said Danita, "how do you feel?"

Cathy thought for a moment, then shrugged slightly. "Better. Worse. I don't know."

"Did you expect your husband to forgive you?"

"No," said Cathy. "No, trust is very important to Peter—and to me. I . . . I expected our marriage to be over."

"And is it?"

Cathy looked out the window. "I don't know."

"Do you want it to be?"

"No—absolutely not. But—but I

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want Peter to be happy. He deserves better."

Danita nodded. "Did he tell you that?"

"No, of course not. But it's true."

"True that he deserves better?"

Cathy nodded.

"You seem to be a fine person. Why would you say that?"

Cathy said nothing.

Danita leaned back in her chair. "Has your marriage always been good?"

"Oh, yes."

"Never any separations or anything like that?"

"No—well, we broke up once while we were dating."

"Oh? Why?"

A small shrug. "I'm not sure. We'd been dating for close to a year while still in university. Then one day, I just broke up with him."

"And you don't know why?"

Cathy looked out the window again, as if drawing power from the sunlight. She closed her eyes. "I guess . . . I don't know, guess I couldn't believe anyone could love me so unconditionally."

"And so you pushed him away?"

She nodded slowly. "I guess so."

"Are you pushing him away again? Is that what your infidelity is about, Cathy?"

"Maybe," she said slowly. "Maybe."

Danita leaned slightly forward. "Why do you think no one could love you?" she said.

"I don't know. I mean, I know Peter loves me. We've been together for a long time, and that's been the one absolute constant in my life. I *know* it. But, still, even after all these years, I have trouble believing it."

"Why?"

An infinitesimal lifting of shoulders. "Because of who I am."

"And who are you?"

"I'm—nothing. Nothing special."

Danita steepled her fingers. "It sounds like you're not very confident."

Cathy considered this. "I guess I'm not."

"But you say you went to university?"

"Oh, yes. I made the dean's list."

"And your job—do you do well at that?"

"I guess. I've been promoted several times. But it's not a hard job."

"Still, it sounds like you've done just fine over the years."

"I suppose," said Cathy. "But none of that matters."

Danita raised her eyebrows. "What's your definition of something that matters?"

"I don't know. Something people notice."

"Something *which* people notice?"

"Just people."

"Does your husband—Peter, is it? Does Peter notice when you achieve something?"

"Oh, yes. I do ceramic art as a hobby—you should have seen him bubbling over when I had a showing at a small gallery last year. He's always been like that, boosting me—right from the beginning. He threw a surprise party for me when I graduated with honors."

"And were you proud of yourself for that?"

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"I was glad university was finally over."

"Was your family proud of you?"

"I suppose."

"Your mother?"

"Yes. Yes, I guess she was. She came to my graduation."

"*What about your father?*"

"No, he didn't attend."

"Was he proud of you?"

A short, sharp laugh.

"Tell me, Cathy: was your father proud of you?"

"Sure." Something strained in her voice.

"Really?"

"I don't know."

"Why don't you know?"

"He never said."

"Never?"

"My father is not a . . . demonstrative man."

"And did that bother you, Cathy?"

Cathy lifted her eyebrows. "Honestly?"

"Of course."

"Yes, it bothered me a lot." She was trying to remain calm, but emotion was creeping into her voice. "It bothered me an awful lot. No matter what I did, he never praised it. If I'd bring home a report card with five As and a B, all he'd talk about was the B. He never came to see me perform in the school band. Even to this day, he thinks my ceramics are silly. And he never . . . ."

"Never what?"

"Nothing."

"Please, Cathy, tell me what you're thinking."

"He never once said he loved me. He even signed birthday cards—cards that my mother had picked out for him—'Dad.' Not 'Love, Dad'—but just 'Dad.' "

"I'm sorry," said Danita.

"I tried to make him happy. Tried to make him proud of me. But no matter what I did, it was like I wasn't *there*."

"Have you ever discussed this with your father?"

Cathy made a noise in her throat. "I've never discussed *anything* with my father."

"I'm sure he didn't mean to hurt you."

"But he *did* hurt me. And now I've hurt Peter."

Danita nodded. "You said that you didn't believe anyone could love you unconditionally."

Cathy nodded.

"Is that because you felt your father never loved you?"

"I guess."

"But you think Peter loves you a lot?"

"If you knew him, you wouldn't have to ask. People are always saying how much he loves me, how obvious it is."

"Does Peter tell you he loves you?"

"Oh, yes. Not every day of course, but often."

Danita leaned back in her chair. "Perhaps your problems with Peter are related to your problems with your father. Down deep, perhaps you felt that no man could love you because your father had eroded your self-esteem. When you found a man who *did* love you, you couldn't believe it, and you tried—and are still trying—to push him away."

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Cathy was immobile.

"It's a common enough scenario, I'm afraid. Low self-esteem has always been a big problem among women, even today."

Still immobile, except for chewing her lower lip.

"You have to realize that you are not worthless, Cathy. You have to recognize the value in yourself, see in yourself all the wonderful qualities Peter sees in you. Peter doesn't put you down, does he?"

"No. Never. As I said, he's very supportive."

"Sorry to have to ask again. It's just that women often end up marrying men who are like their fathers, just as men often end up marrying women who are like their mothers. So Peter isn't like your father?"

"No. No, not in the least. But, then, Peter pursued me. I don't know what kind of man I was looking for. I don't even know if I was looking at all. I think—I think I just wanted to be left alone."

"What about the man you had the affair with? Was he the kind of man you were looking for?"

Cathy snorted. "No."

"You weren't attracted to him?"

"Oh, Hans was cute, in a chubby way. And there was something disarming about his smile. But I didn't go after him."

"Did he treat you well?"

"He was a smooth talker, but you could tell it was all just talk."

"And yet it worked."

Cathy sighed. "He was persistent."

"Did this Hans remind you of your father?"

"No, of course not," Cathy said immediately, but then she paused. "Well, I suppose they have some things in common. Peter would say they're both dumb jocks."

"And was Hans good to you during your relationship?"

"He was terrible to me. He'd ignore me for weeks on end, while he was presumably involved with someone else."

"But when he came back to you, you'd respond."

She sighed. "I know it was stupid."

"No one is judging you, Cathy. I just want to understand what went on. Why did you keep going back to Hans?"

"I don't know. Maybe . . . ."

"Yes?"

"Maybe it was just that Hans seemed more the kind of guy I deserved."

"Because he treated you terribly."

"I guess."

"Because he treated you like your father."

Cathy nodded.

"We have to do something about your self-esteem, Cathy. We have to make you realize that you deserve to be treated with respect."

Cathy's voice was small. "But I don't . . . ."

Danita let out a slow, whispery sigh. "We've got our work cut out for us."

Later that evening, Peter and Cathy were sitting in their living room, Peter on the couch and Cathy alone in the love seat across the room.

Peter didn't know what was going

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to happen, what the future held. He was still trying to deal with it all. He'd always tried to be a good husband, always tried to show a genuine interest in her job. There was no reason to change that, he figured, and so, as he had often done in the past, he asked, "How was work today?"

Cathy put down her reader. "Fine." She paused. "Toby brought in fresh strawberries."

Peter nodded.

"But," she said, "I left early."

"Oh?"

"I, ah, went to see a counselor."

Peter was surprised. "You mean like a therapist?"

"Sort of. She works for the Family Service Association—I found them using directory assistance."

"Counselor . . . ." said Peter, chewing over the word. Fascinating. He met her eyes. "I would have gone with you, if you'd asked."

She smiled briefly but warmly. "I know you would have. But, ah, I wanted to sort things out for myself."

"How did it go?"

She looked at her lap. "OK, I guess."

"Oh?" Peter leaned forward, concerned.

"It was a little upsetting." She lifted her gaze. Her voice was small. "Do you think I have low self-esteem?"

Peter was quiet for a moment. "I, ah, have always thought that perhaps you underestimated yourself." He knew that was as far as he should go.

Cathy nodded. "Danita—that's the counselor—she thinks it's related to my relationship with my father."

The first thought in Peter's mind was a snide comment about Freudians. But then the full measure of what Cathy said hit him. "She's right," Peter said, eyebrows lifting. "I hadn't seen it before, but of course she's right. He treats you and your sister like crap. Like you had been boarders, not his children."

"Marissa is in therapy, too, you know."

Peter hadn't known, but he nodded. "It makes sense. Christ, how could you have a positive self-image, growing up in an environment like that? And your mother—" Peter saw Cathy's face harden and he stopped himself. "Sorry, but as much as I like her, Bunny is not, well, let's say not the ideal role model for the twenty-first-century woman. She's never worked outside the home, and, after all, your father doesn't seem to treat her much better than he treated you or your sister."

Cathy said nothing.

It was obvious now, all of this. "God damn him," said Peter, getting to his feet, pacing back and forth. He stopped and stared at the Alex Colville painting behind the couch. "God damn him to hell."

CHAPTER 8

Tuesday was the standard night for Peter and Sarkar to have dinner together. Sarkar's wife Raheema took a course on Tuesdays, and Peter and Cathy had always given each other time to pursue separate interests. Peter was more relaxed this evening, now that he'd decided not to discuss Cathy's infidelity with Sarkar. They hashed through more prosaic family

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news, international politics, the Blue Jays's stunning performance and the Leafs's lousy one. Finally, Peter looked across the table and cleared his throat. "What do you know about near-death experiences?"

Sarkar was having lentil soup this evening. "They're a crock."

"I thought you believed in that kind of stuff."

Sarkar made a pained face. "Just because I'm religious doesn't mean I am an idiot."

"Sorry. But I was talking to a woman recently who had had a near-death experience. She certainly believed it was real."

"She have the classic symptoms? Out-of-body perspective? Tunnel? Bright light? Life review? Sense of peace? Encounters with dead loved ones?"

"Yes."

Sarkar nodded. "It is only when taken as one big thing that NDEs are inexplicable. The individual components are easy to understand. For instance, do this: close your eyes and picture yourself at dinner last night."

Peter closed his eyes. "OK."

"What do you see?"

"I see me and Cathy at The Olive Garden on Keele."

"Don't you ever eat at home?"

"Well, not often," said Peter.

"DINKs," said Sarkar, shaking his head—double income, no kids. "Anyway, realize what you just said: you picture yourself and Cathy."

"That's right."

"You are seeing yourself. The image you conjure up isn't from the point of view of your eyes, a meter and half off the floor or however high up they are when you're sitting down. It's a picture of yourself as seen from outside your own body."

"Well, I guess it is, at that."

"Most human memory and dream imagery is 'out of body.' That's the way our minds work both when recalling things that really happened and in fantasizing. There's nothing mystical about it."

Peter was having another heart-attack kit. He rearranged the slices of smoked meat on the rye bread. "But people claim to be able to see things they couldn't possibly have seen, like the manufacturer's name on the light unit mounted above their hospital bed."

Sarkar nodded. "Yeah, there are reports like that, but they aren't crisp—they don't stand up to scrutiny. One case involved a man who worked for a company that manufactured hospital lighting: he had recognized a competitor's unit. Others involved patients who had been ambulatory before or after the NDE and had had plenty of time to check out the details for themselves. Also, many times the reports are either unverifiable, such as 'I saw a fly sitting on top of the x-ray machine,' or just flat-out wrong, such as 'there was a vent on the top of the respirator,' when in fact there was no vent at all."

"Really?"

"Yes," said Sarkar. He smiled. "I know what to get you for Christmas this year: a subscription to *The Skeptical Inquirer.*"

"What's that?"

"A journal published by The Com-

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mittee for the Scientific Investigation of Claims of the Paranormal. They blow holes in this sort of thing all the time."

"Hmm. What about the tunnel?"

"Have you ever had a migraine?"

"No. My father used to get them, though."

"Ask him. Tunnel vision is common in severe headaches, in anoxia, and lots of other conditions."

"I guess. But I'd heard that the tunnel was maybe a recollection of the birth canal."

Sarkar waved his soup spoon in Peter's direction. "Ask any woman who's had a baby if the birth canal is even remotely like a tunnel with a wide opening and a bright light at the end. The baby is surrounded by contracting walls of muscle; there's no tunnel. Plus, people who were delivered by Caesarean section have recounted the NDE tunnel as well, so it can't be some sort of actual memory."

"Hmm. What about the bright light at the end of the tunnel?"

"Lack of oxygen causes overstimulation of the visual cortex. Normally, most of the neurons in that cortex are prevented from firing. When oxygen levels drop, the first thing to cease functioning is the disinhibitory chemicals. The result is a perception of bright light."

"And the life review?"

"Didn't you take a seminar once at the Montreal Neurological Institute?"

"Umm—yes."

"And who was the most famous doctor associated with that Institute?"

"Wilder Penfield, I guess."

"You guess," said Sarkar. "He's on a bloody stamp, after all. Yes, Penfield, who did work on directly stimulating the brain. He found it easy to elicit vivid memories of long-forgotten things. Again, in an anoxia situation, the brain is *more* active than normal because of the loss of disinhibitors. Neural nets are firing left and right. So the flooding of the brain with images from the past makes perfect sense."

"And the sense of peace?"

"Natural endorphins, of course."

"Hmm. But what about the visions of long-dead friends? The woman I spoke to saw her dead twin sister, Mary, who had died shortly after birth."

"Did she see an infant?"

"No, she described the vision as looking like herself."

"The brain isn't stupid," said Sarkar. "It knows when it may be about to die. That naturally gets one thinking about people who are already dead. Here is the crisp point, though: there are cases of little children having near-death experiences. Do you know who they see visions of?"

Peter shook his head.

"Their parents or their playmates. People who are still alive. Children don't know anyone who has already died. If the NDE really was a window into some afterlife, they wouldn't see people who are alive."

"Hmm," said Peter. "You know, the woman who had seen her sister Mary had her NDE while on the phone talking to *another* woman named Mary."

Sarkar looked triumphant. "The power of suggestion. It's all just a normal, explicable brain reaction." The

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server came with the bill. Sarkar glanced at it. "My religion teaches that we *do* continue on after this existence, but the near-death experience has nothing to do with real life after death. If you want to know what that's like, I'll give you a copy of the Koran."

Peter reached for his wallet to pay his half of the tab. "I think I'll pass."

CHAPTER 9

Peter Hobson's sister-in-law was named Marissa. In 2004, her first child had died of Sudden Infant Death Syndrome: she had simply stopped breathing, without any fuss, sometime during her third evening of life. Marissa and her ex-husband had used a standard baby monitor, a microphone that broadcast to a receiver they carried about the house.

But little Amanda had died quietly.

When Marissa had had another baby a year later, she refused to leave the child's side. Day or night, for months on end, she would always have the baby in her sight. Intellectually she knew that infant deaths just sometimes happened, but emotionally she blamed herself—if she had been with Amanda when her breathing had stopped, maybe she could have saved her.

Back then, Peter had been working on designs for touchless medical instrumentation. With AIDS continuing to plague the world, there was a big demand for units that didn't have to come into contact with a patient's body. At-a-distance heart-rate monitors were easy enough to develop, using declassified sensing equipment originally created for espionage. And detecting brain activity was usually done at a distance anyway—with electrodes separated from the brain by the thickness of the scalp and skull. Eventually, Peter found a way to read the rudiments of brain activity over a great distance, with nothing touching the patient's skin except a low-wattage infrared laser.

And so the Hobson Baby Monitor was born—a device that could report the vital signs of an infant in another room. He gave the prototype to Marissa and her husband. The monitor's built-in alarms would warn them immediately if their baby was in distress. They were delighted with the unit, and at Cathy's urging, Peter quit his job at East York General Hospital and started a little company to sell his baby monitors.

And then, one morning, Peter was lying next to his wife in bed. He needed to pee. Looking at the clock radio, he saw it was 6:45 A.M. The alarm would go off at seven. If Cathy was sleeping lightly, Peter knew that his getting up now would wake her, depriving her of her last quarter-hour of sleep, something he'd hate to do.

Peter lay there, enduring the pressure in his bladder. He wished he knew whether she was sleeping soundly. Maybe she was even already awake, but just had her eyes closed.

And then it hit him—a completely different use for his monitoring technology. The product appeared full-blown in his mind. A panel on the wall opposite the bed, with two clusters of readouts, one for each person in the bed. In each cluster, there'd be

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a big LED and a small one. The big one would indicate the person's current sleep state, and the small one would indicate the state he or she was moving into. There'd also be a digital counter indicating how long until the transition between one state and the next would take place—after just a few nights' training, the unit would have the individual users' sleep cycles down pat.

The LEDs would change color: white would mean the person was awake; red would mean the person was in a light sleep and would definitely be disturbed by any noises or movement. Yellow would mean the person was in a medium sleep, and so long as care was taken, one could get up and go to the bathroom, or cough, or whatever, without disturbing one's partner. Green would mean the person was in deep sleep, and you could probably do limbo dancing in the bed without disturbing him or her.

It would be pig-simple to read: a big yellow light with a small green one, and 07 showing on the counter would mean if you got up now, you might disturb your partner, but if you could hold off for seven minutes, she would be fast asleep and you could slip out without waking her.

As the urinary pressure gave Peter a typical early-morning erection, he realized something else. He'd often awoken horny at two or three A.M. and wondered if his wife was awake, too. If she had been, they'd probably have made love, but Peter would never dream of waking her up for that. But if the monitor happened to show white lights for both of them, well, then, what had started out as the Hobson Baby Monitor might end up being responsible for lots of new babies. . . .

As time went by, Peter refined his system. All the telephones in the Hobson house were now hooked up to a Hobson Monitor, and from there to the household computer. Whether the phones rang at all, or just signaled incoming calls with flashing lights, depended on Peter and Cathy's sleep states.

At 3:17 A.M., a call was indeed detected. Moments before, Peter had been asleep, but he was now heading to the *en suite* bathroom, which had a small voice-only telephone. As he entered its indicator started to flash. Peter closed the door, sat down on the toilet, and picked up the handset.

"Hello," he said, his voice thick and dry.

"Dr. Hobson?" said a man's voice.

"Yes."

"This is Sepp van der Linde at Carlson's Chronic Care. I'm the head night nurse."

"Yes?" Peter fumbled for a drinking glass and filled it from the tap.

"I think Mrs. Fennell is going to pass on tonight. She's had another stroke."

Peter felt a small twang of sadness. "Thank you for letting me know. Is my equipment all set up still?"

"Yes, sir, it is, but—"

He fought to stifle a yawn. "Then I'll come by in the morning to pick up the data disk."

"But Dr. Hobson, she's asking for you to come."

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"Me?" said Peter.

"She said you're her only friend."

"I'm on my way."

Peter arrived at the chronic-care facility about 4:00 A.M. He showed his pass to the security guard and took the elevator to the third floor. The door to Mrs. Fennell's room was open and the incandescent light directly above her head was on, although the main overhead fluorescents were out. A row of four green LEDs pierced the gloom beside the bed, showing that Peter's equipment was working properly. A nurse sat on a chair next to the bed, a bored look on her face.

"I'm Peter Hobson," Peter said. "How is she?"

Mrs. Fennell stirred. "Pe-ter," she said, but the effort of even those two syllables seemed to visibly weaken her.

The nurse got up and moved over to stand next to Peter. "She had a stroke about an hour ago, and Dr. Chong expects she'll have another one shortly; there are several clots in the arteries feeding her brain. We offered her something for the pain, but she said no."

Peter stepped over to his recording unit and turned on the screen, which immediately came to life. A series of jagged lines traced from left to right. "Thank you," he said. "I'll stay with her. You can go now, if you like."

The nurse nodded and left. Peter sat in the chair, the vinyl back warm from the nurse. He reached out and took Mrs. Fennell's left hand. There was a catheter inserted into the back of it, a tube leading to a drip bag mounted just beside the chair. Her hand was thin, small bones covered by translucent skin. Peter encircled Mrs. Fennell's fingers with his own. She squeezed his hand very softly.

"I'll stay with you, Mrs. Fennell," said Peter.

"P—P—"

Peter smiled. "That's right, Mrs. Fennell; it's me, Peter."

She shook her head ever so slightly. "P—P—," she said again, and then, with great effort, "Peg—"

"Oh, that's right," said Peter. "I'll stay with you, *Peggy.*"

The old woman smiled ever so slightly, her mouth just another line across her face. And then, without any fuss, her fingers went limp in Peter's hand and her eyelids slid very slowly shut. On the monitor, the green tracings had turned into a series of perfectly straight horizontal lines. After several moments, Peter retrieved his hand, blinked slowly a few times, and went to find the nurse.

CHAPTER 10

Peter took the superEEG recording with him when he left the chronic-care facility. By the time he got home, Cathy was getting ready for work, nibbling at a piece of dry whole-wheat toast and sipping a cup of tea. He'd left her a message with the household computer, so she'd know where he was.

"How did it go?" asked Cathy.

"I got the recording," said Peter.

"You don't seem very happy."

"Well, a very nice lady died tonight."

Cathy looked compassionate. She

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nodded.

"I'm exhausted," said Peter. "I'm going back to bed." He gave her a quick kiss, and did just that.

Four hours later Peter woke up with a headache. He stumbled to the bathroom where he shaved and showered. He then filled a large tumbler with Diet Coke, got the disk, and went to his study.

His home system was more powerful than the mainframe he'd had to share access to as a student at university. He turned it on, inserted the disk into the drive, and activated the wall monitor on the other side of the room. Peter wanted to see the moment at which the last neuron had fired, the moment at which the last synapse had been made. The moment of death.

He selected a graphic display mode and played a few seconds of the data, having the computer plot every location at which a neuron had fired. Not surprisingly, the image on the screen looked exactly like a silhouette of a human brain. Peter used an edge-tracing tool to draw the outline of Mrs. Fennell's brain. There was enough data to generate the picture three-dimensionally; Peter rotated the image until the brain silhouette was facing him directly, as if looking at the late Mrs. Fennell straight in the optic nerves.

He let the data play in real time. The computer looked for patterns in the firing neurons. Any connected series that fired once was color-coded red; twice, orange; three times, yellow; and so on through the seven colors of the spectrum. The picture of the brain looked mostly white: the combined effect of all the different colors of tiny dots. Peter occasionally zoomed in to see a close-up of one section of the brain, lit up with strings of infinitesimal Christmas lights.

As he watched, he could clearly see the stroke that had proved the final straw for Peggy Fennell. The color-coding scheme was refreshed every tenth of a second, but soon an area of blackness began to grow in her left temporal lobe, just below the Sylvian fissure. It was followed by an increase in activity, with the whole brain growing brighter and brighter as disinhibition caused neurons to fire again immediately after they'd last fired. After several moments, a complex network of purple lights was visible throughout her brain, a whole series of neural nets being triggered in identical patterns over and over as her brain spasmed. Then the nets began to fade, and no new ones replaced them. After ninety years of service, Peggy Fennell's brain was giving up the ghost.

Peter had hoped to be able to watch it all dispassionately. It was just data, after all. But it was also Peggy, that brave and cheerful woman who had held his hand as she passed from life into lifelessness.

The data continued to be plotted, and soon there were only a few patterns of light, like constellations on a foggy night, flickering on the screen. When the activity did stop, it did so without any apparent flourish. Not a bang. Not a whimper. Just nothingness.

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Except....

What was that?

A tiny flash on the screen.

Peter reversed the recording, then played it back again at a much slower speed.

There was a minuscule pattern of purple lights—a persistent pattern, a pattern that kept firing over and over again.

And it was moving.

Neurons couldn't really move, of course. They were physical entities. But the recorder was picking up the same pattern over and over again, just slightly displaced to the right each time. The recorder allowed for such displacements: neurons didn't always fire in exactly the same way, and the brain was gelatinous enough that movements of the head and the pulsing of blood could slightly change the physical coordinates of a neuron. The pattern moving across the screen must have been propagating from neuron to adjacent neuron in steps small enough that the recorder mistook the individual increments for activity within the same neurons. Peter glanced at the scale bar at the bottom of the wall screen. The violet pattern, a complex knot like intestines made of neon tubes, had already shifted five millimeters, far more than any neuron could move within the brain except in the case of a major blow to the head, something Peggy Fennell had most assuredly not suffered.

Peter adjusted a control. The playback speeded up. No doubt about it: the knot of violet pinpricks was moving to the right, pretty much in a straight line. It rotated a bit as it moved, like a tumbleweed blown by a desert wind. Peter stared in open-mouthed wonder. It continued to move, passing over the corpus callosum into the other hemisphere, past the hypothalamus, and into the right temporal lobe.

Each part of the brain was normally reasonably isolated from the others, and the kinds of electrical waves typical of, say, the cerebral cortex were foreign to the cerebellum, and vice versa. But this tight knot of purple light was moving without changing its form through structure after structure.

An equipment malfunction, thought Peter. Oh, well. Nothing ever worked right the first time.

Except....

Except Peter couldn't think of anything that would cause this kind of malfunction.

And still the pattern moved across the screen.

Peter tried to conjure up another explanation. Could a static discharge, perhaps from Peggy's hair rubbing against the pillow, have caused this effect? Of course, hospital pillows are designed to be anti-static, precisely so they won't mess up delicate recording equipment, and Peggy, after all, had had thinning, white hair. Besides, she'd been wearing his scanning skullcap.

No, it must be caused by something else.

The pattern was getting close to the outer edge of the brain. Peter wondered if it would dissipate on the convoluted surface of the cortex or maybe bounce back, spinning the

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other way, like a video game inside the head.

It did neither.

It reached the edge of the brain... and kept right on going, through the membrane that encased the brain.

Astonishing.

Peter touched some keys, overlaying an extrapolated outline of Mrs. Fennel's head over the silhouette of her brain. He mentally kicked himself for not having done this sooner. It was obvious where the knot of light was heading.

Straight for the temple.

Straight for a hole in her skull.

It continued along, through the opening in the bone, through the thin veneer of muscle that overlaid the skull.

Surely, thought Peter, it was going to break up. Yes, there are nerves at the temple; that's why it hurts to be struck there. Yes, there are nerves in muscle tissue, too, including the jaw muscles that overlay the temple. And, yes, there are nerves shot through the lower layers of the skin. Even if the pattern had some form of cohesion, Peter expected to see a change here. The nerves outside the actual brain are much less densely packed. The pattern might balloon in size, drawn between the points of more diffused neural tissue.

But it did not. It continued, exactly the same size, tumbling slowly end over end, through the muscle, through the skin, and—

Out. Past the sensor field.

It didn't break up. It simply left. And yet it had held its cohesion. The pattern had remained intact right up to the moment the sensor web lost it.

Incredible, thought Peter. Incredible.

He scanned the wall, looking for signs of other active neural nets.

But there were none.

Peggy Fennell's brain showed as an unblemished silhouette, devoid of electrical activity.

She was dead.

Dead.

And something had left her body.

Something had left her brain.

Peter felt his own head wheeling.

It couldn't be.

It could *not* be.

He reversed the recording, played it back from a different angle.

Why had the knot of light moved from the left hemisphere to the right? The other temple had been closer.

Ah, but Peggy had been lying down, her head on her pillow. Her left temple had been facing into the pillow; it was her right one that had been exposed to air. Even though it had been farther away, it represented the easier escape route.

Peter played the recording back again and again. Different angles. Different plotting methods. Different color-encoding schemes. It didn't matter; the result was the same. He compared the time-coded recordings to Peggy's other vital signs—pulse, respiration, blood pressure. The knot of light left just after her heart stopped, just after she'd breathed her last.

Peter had found exactly what he was looking for: an unequivocal

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marker that life was now over, an indisputable sign that the patient was just meat, ready for organ harvesting.

Marker.

That wasn't the right word, and he knew it. He was deliberately avoiding even thinking it. And yet, there it was, recorded by his own ultrasensitive instruments: the departure from her body of Peggy Fennell's very own soul.

Peter knew that when he asked Sarkar to come at once to his house, Sarkar would do so. Peter couldn't contain his excitement when Sarkar arrived. He was trying, and probably failing, to suppress a grin. He took Sarkar into his den, then played back the recording of Peggy Fennell's death once more.

"You faked that," said Sarkar.

"No, I didn't."

"Oh, come on, Peter."

"Really. I haven't even done any cleanup of the data. What you just saw is exactly what happened."

"Play that last bit again," said Sarkar. "One one-hundredth speed."

Peter touched buttons.

"Subhanallah," said Sarkar. "That's incredible."

"Isn't it, though?"

"You know what that is, don't you?" said Sarkar. "Right there, in crisp images. That's her *nafs*—her soul—leaving her body."

To his surprise, Peter found himself reacting negatively when he heard that idea said aloud. "I knew you were going to say that."

"Well, what else could it be?" asked Sarkar.

"I don't know."

"Nothing," said Sarkar. "That's the only thing it could be. Have you told anyone about this yet?"

"No."

"How do you announce something like this, I wonder? In a medical journal? Or do you just call the newspapers?"

"I don't know. I've only just begun to think about that. I suspect I'll call a press conference."

"Remember Fleischmann and Pons," cautioned Sarkar.

"The cold-fusion guys? Yeah, I know they jumped the gun, and ended up with egg on their faces. I'll have to get some more recordings of the thing. I've got to be sure this happens to everyone, after all. But I can't wait forever. Someone else will stumble on this soon enough."

"What about patents?"

Peter nodded. "I've thought about that. I've already got patents on most of the technology in the super-EEG—it's an incremental improvement on the brain scanner we built for your AI work, after all. I'm certainly not going to go public until I've got the whole thing protected."

"When you do announce it," said Sarkar, "there will be a ton of publicity. This is as big as it gets. You've proven the existence of life after death."

Peter shook his head. "You're going beyond the data. A small, weak electrical field leaves the body at the moment of death. That's all; there's nothing to prove that the field is conscious or living."

"The Koran says—"

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"I can't rely on the Koran, or the Bible, or anything else. All we know is that a cohesive energy field survives the death of the body. Whether that field lasts for any appreciable time after departure, or whether it carries any real information, is completely unknown—and any other interpretation at this point is just wishful thinking."

"You're being deliberately obtuse. It's a soul, Peter. You know that."

"I don't like using that word. It—it prejudices the discussion."

"All right, call it something else if you like. Casper the Friendly Ghost, even—although I'd call the physical manifestation the soulwave. But it exists—and you know as well as I do that people are going to embrace it as an honest-to-goodness soul, as proof of life after death." Sarkar looked his friend in the eye. "This will change the world."

Peter nodded. There wasn't anything else to say. ■

To be continued in the next issue.

The degree of political intrigue in a work environment is inversely proportional to the actual work related abilities of the participants.

An incompetent organization promotes those who are nonthreatening and who it perceives fulfill its incompetency requirements.

A competent organization knows the difference between the wheat germ and the chaff, and which is valuable.

An organization that values style over substance is destined to be beaten in the market place by one that does not.

—Michael Fendley

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BIOLOG Jay Kay Klein

Becoming a science fiction writer seemed impractical to Robert J. Sawyer. He was all set to study paleontology when it occured to him there are only a couple of dozen persons in the world making a living digging up dinosaurs, whereas there are a couple of hundred science fiction writers.

Raised in Toronto, Rob decided to pursue entirely practical paths towards being a writer and eventually a full-time science fiction career. He enrolled in Toronto's Ryerson Polytechnical Institute for a degree in radio and television arts, with emphasis on script writing. After finishing his B.A., he taught a year at Ryerson and worked briefly at an SF book store.

Rob started selling articles on computers and high tech to Canadian magazines and newspapers, and doing writing assignments for high-tech companies and government offices. SF stories sold very slowly while he gained experience in handling fiction and especially characterization. His first sale was to a planetarium in Rochester, NY, which adapted a short story as part of a starshow. After putting together enough money from sales to support himself for a while, he turned to writing SF full time. Now, he mostly turns down outside assignments even though they pay ten to twenty times as much per word as SF short stories.

The real money lies in novels. *Golden Fleece* appeared in 1990; *Far-Seer*, 1992; *Fossil Hunter*, 1993; *Foreigner* and *End of an Era*, 1994. Three more books are scheduled for 1996.

Rob has a dual approach to science fiction. One is business-oriented. The other is a to provide a serious underpinning for whatever he writes. To make a living, he decided he must be-

Biolog continued on page 112

Photo by Carolyn Clink

Robert J. Sawyer

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Charles L. Harness

THE BUG, THE MOUSE, AND CHAPTER 24

In August 1993 the United States Patent and Trademark Office added chapter 24, Biotechnology, to its *Manual of Patent Examining Procedure*. This means, if you want a biotech patent, you must follow the requirements detailed in chapter 24.

Actually it means more than that—a lot more. For the first time in its long and distinguished history the Patent Office has singled out one specific technical field and has given it its very own chapter in the MPEP. (We checked back for fifty years, into the MPEP's ancestral *Wolcott's Manual of Patent Office Procedure, 8th Ed., 1943.)* Genetic engineering now has its special patent rules, all set forth in 37 double-columned pages of fine print in chapter 24. Not even superconductors or inventions to benefit the environment ever received this kind of attention. The Office waxes lyrical: "It [recombinant DNA] has been likened in importance to the discovery of nuclear fission and fusion."[1]

How? When? Why? What led the Patent Office to chapter 24?

We will say at the outset, the Office was not always so enthusiastic about biotechnology. Only after two defeats—one major, one minor—did the patent examiners throw in the towel and decide to join the flow.

The first defeat (and it was a big one, and totally unexpected) was dealt by a microscopically-small challenger: a bacterium. The second defeat (arguably an inevitable consequence of the first) was likewise diminutive: a mouse. The consequences in both cases were all out of proportion to the subject matter.

Let's look at these two landmark patent battles.

Chakrabarty's Bug

In 1972 Dr. Ananda M. Chakrabarty, a research chemist with the General Electric Company, filed a patent application directed to "a bacterium from the genus *Pseudomonas* containing therein at least two stable energy-generating plasmids, each of said plasmids providing a separate hydrocarbon degradative pathway." Dr. Chakrabarty had taken a bacterium and had inserted into it several plasmids, each of which was capable of digesting a different kind of hydrocarbon. The new strain of *Pseudomonas*

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could thereby degrade all the oil in a spill that contained several different hydrocarbons. (Curiously, the "synthetic" bacterium was made not by recombinant-DNA techniques, but by conventional genetic procedures.)

The Office allowed claims to making the new bacterium and to its use in cleaning up oil spills. But the examiner adamantly refused to allow claims to the bacterium itself. His position was, you can't patent life. The bacterium was not within the four statutory classes of patentable subject matter: "... Process, machine, manufacture, composition of matter...."[2] His supervisor backed him up. G.E. appealed to the Patent Office Board of Appeals. The Board sustained the examiner. G.E. then appealed to the Court of Customs and Patent Appeals.

And surprise, surprise! The C.C.P.A. reversed the Patent Office, first in a 3:2 decision, and then, after reargument, 4:1. (Statistically, the C.C.P.A. upholds most patent office decisions.) Judge Rich, speaking for the majority, concluded that the modified bacterium fell within one or both of the statutory classes, "manufacture" or "composition." In essence, the Court said, sure, it's alive, but it's the work of man.

Before we go on, let's take a look at the Court of Customs and Patent Appeals, at least as it was then constituted. (Its functions have subsequently expanded.) A good description of the Court will be found in an article written by the Chief Judge, Howard T. Markey.[3] We note that there are five judges and twelve technical advisors. Each judge individually hires two of these advisors, and the chief technical advisor and his assistant are assigned to the court as a whole. The advisors assigned to the individual judges serve two years. Each must have at least two degrees, one in law and one in science, plus three to five years in a law-science environment. There is generally at least one Ph.D. in the group. By contrast (according to Judge Markey), "Of 600 federal judges, I know of only 4 with technological backgrounds prior to appointment." [In 1994 there were actually about 850 federal judgeships, some awaiting filling.[4]]

Considering their technical support, we have to believe that the C.C.P.A. knew at least as much about DNA and genetics engineering as the Patent Office.

Next surprise: The Patent Office appealed to the U.S. Supreme Court.

Now the highest court was under no duty to take the appeal. In fact, the Court receives three or four thousand requests to hear cases every term, and the justices try to keep the docket down to a hundred or so, including carry-overs from the prior term. So they have to be choosy. In fact, most of the justices hate patent cases. Their grasp of the technology involved is generally dismally inadequate. Nevertheless they take an occasional patent case out of a sense of duty, and they are fully aware that the experts will later write long articles in the law journals explaining that the law was perfectly clear before the Court befuddled the issues. But *Chakrabarty* looked safe and simple, so they took it.

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Ordinarily, when the Supreme Court takes a case, the chances are they're going to reverse the decision of the court below. There are various ways to reverse without actually saying, "We reverse." A time-honored procedure is simply to remand the case with instructions to reconsider it "in light of" something or other. Everybody gets the message. In this instance that "something or other" was the Supreme Court's decision in another patent appeal, *Parker v. Flook*,[5] where the high court had said the invention was really just a method of doing business, and hence outside the statutory fields of patentable subject matter. The Patent Office, opined the Court, should "... proceed cautiously when ... asked to extend patent rights into areas wholly unforeseen by Congress." So now (it's 1978), gently but firmly, the Supreme Court was telling the C.C.P.A., Chakrabarty's bug is outside §101. Kill it. No patent.

So what did the C.C.P.A. do? For perhaps the first time in its history, the C.C.P.A. challenged the U.S. Supreme Court on a vital issue. The language is simple, serene. *Flook*, said the C.C.P.A., throws no light on the case. The bacterium is patentable.

This was *lèse-majesté* on an awesome scale.

The astonished Patent Office immediately appealed back to the Supreme Court.

And right here let's pause a moment. So far, the Patent Office looks like the villain in the piece, standing in the way of progress. Nay, not so. The Office, let us recall, has two basic functions. One is to reward inventors with patents on meritorious inventions. The other is zealously to protect the public from the monopolies of unpatentable inventions. It is in the latter duty that the Office was attempting to function. The Office had every reason to believe the high court would support its efforts to protect the public.

On this last and final appeal the Supreme Court could no longer dodge the issue. The judges had to decide, one way or the other, whether a man-modified self-replicating bacterium was patentable. The Court watchers had no doubt what the Court would do. It would say, we support the Patent Office. We will not grant claims to a living bacterium.

In reaching its decision the Court would also take note of side issues pointed out in various *amicei curiae* documents filed in the case, such as danger to the community of unbridled research in recombinant DNA. No joke. In 1978 a plaintiff brought suit in a federal court in the District of Columbia to shut down a recombinant DNA research laboratory as dangerous to the environment. (He lost.) In the same time frame the City Council of Cambridge, Mass., had enforced a three-month moratorium on similar research in Harvard University.

Furthermore, the judges would be expected to spell out, that if Congress had wanted to include life in the statutory classes of §101, they would have said so. Also, the Patent Office Solicitor complained that patenting life would require the Office to pro-

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cess thousands of additional patent applications. (As it turned out, he was quite right.) This would be a nightmare that only a group supervisor would appreciate. It's like a businessman calling his wife at five o'clock that he's bringing the Rotary Club home for supper.

Nevertheless—

On June 16, 1980 the Court handed down its famous 5:4 decision, overruling the Patent Office and granting the patent.[6]

The opinion is startling on its face and invites reading between the lines. Chief Justice Burger spoke for the Court, joined by Stewart, Blackmun, Rehnquist, and Stevens. The majority was thus heavily loaded with conservatives. Most of the liberals were on the dissent: Brennan, White, Marshall, Powell. (It is perhaps not surprising that Burger and Marshall wound up on opposite sides. It has been reported that Marshall delighted in making Burger uncomfortable. When they met in the halls, Marshall would sing out, "What's shakin', Chief baby?"[7])

Students of the high court generally agree that Chief Justice Burger rarely wrote his own decisions. His clerks did that, subject to his subsequent revisions. It has further been observed that the Chief's scientific background was, well, nil. And yet the decision is scientifically precise and beautifully reasoned. So who wrote it? Not Burger. One of the other majority justices? Unlikely. We'll probably never know exactly. There's no point in asking the Chief, always close-mouthed, and now retired.

But we can speculate. And logic certainly profiles a clerk with scientific background, a rarity in the Court, and perhaps even a facet to be downplayed when the clerk leaves the Sanctum and goes out into private practice, at an entrance salary of $90,000 plus hiring bonus of $35,000.[8] Chief Justice Burger had four clerks, plus an additional two "at large," who might have written the decision. Our Writer would be young, about 26 if a man, about 29 if a woman, a graduate of one of the Ivy League law schools, especially Harvard, Yale, or Columbia, with a possible prior clerkship in one of the lower courts. (We liken Writer to "Q," the person or persons who wrote "Proto-Mark" of the Gospels; or "X," the hypothetical Homer(s) who wrote *The Iliad.)* Quite probably, Writer was more than one person. We like to think that he/she/they visualized and were motivated by the consequences of their decision.

Query: why was *Flook* decisive in 1978 and not even mentioned in 1980? Answer: because Writer had the good sense to let it lie. Nevertheless, Writer gave a body blow to the charge of patenting in areas not foreseen by Congress. If inventions are foreseen, said Writer, they're unpatentable. It's the unforseen inventions that deserve patents.

The same heads-I-win/tails-you-lose paradox had already been noted in exquisite legal idiom by patent lawyer Thomas D. Kiley: ". . . fields of science beyond the precognitions of patent lawmaking politicians may, when they emerge, be unentitled to

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patent protection because not earlier within Congress' contemplation. On the other hand, the "obvious" thing within the mental reach of ordinary lawmakers will prove unpatentable for the usual reasons. Catch-22?"[9] Thus, an invention is unpatentable if unforeseen, but if foreseen, also unpatentable. Yes, Mr. Kiley, it looked like Catch-22, but Writer resolved it very adroitly. We go on.

So *Diamond v. Chakrabarty* is clearly a landmark case. [Sidney A. Diamond was Commissioner of Patents and Trademarks at the time.] It may or may not make money for G.E. Let's hope it does. But its real importance lies in this—beginning in 1980 the burgeoning biochem industry knew that they could get patent protection on their live products, and that investors would be willing to put up money for new plants. (More on this later.)

As we look back at the early eighties, we note in an article by patent lawyer John W. Behringer that "Numerous microbiological research companies are reportedly racing feverishly to develop genetically engineered bacteria capable of rapidly and inexpensively producing scarce medicinal chemicals now available only by extraction from animal or human blood or tissue: insulin, interferon, endorphin, and somatotropin are but a few examples of such sought-after products. The potential profits are exciting and alluring, prompting one to wonder what breadth of patent protection the U.S. Patent Office, and, more importantly, the courts, will accord new bacteria inventions produced by genetic engineering."[10] Behringer concluded, "The Supreme Court's pronouncement in *Chakrabarty* has . . . ushered in a new age of microbiological patent protection in the United States." (Here we cannot resist an aside: we wonder whether Behringer—or anybody—noticed that the physician's symbol, the caduceus, consists of a double helix, with serpentine strands wound in opposite directions, just like DNA!)

Certainly, *Chakrabarty* removed an obstacle in America's biotech race with Japan and Europe. Was any of this in the back of the mind of Writer?

Anyhow, despite astronomic improbabilities, Dr. Chakrabarty finally patented life: U.S. Patent 4,259,444. A first? Oddly, no. Louis Pasteur received U.S. Patent 141,072 in 1873 on a special form of yeast (a living organism), but nobody paid much attention at the time. It was premature.

So who had the last word? The Patent Office. Or at least the last *non*-word. For to this day the MPEP does not list *Chakrabarty* in its Table of Decisions.

Why Patents?

Why all the fuss about patents? As we mentioned above, the answer is economic: the monopoly, though limited in time, helps protect an investment. The embryonic biochemical industry needed patents in order to attract venture capital.

The first money began to materialize following a meeting in 1976 between two men, Dr. Herbert Boyer and Robert A. Swanson, in a San Fran-

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cisco pub. That now famous meeting is memorialized in life-size bronze statues of these two seated at a table in the courtyard of the new Founders Research Center of Genentech, Inc., the company they founded, and the pioneer in the biotech field.

We may take Genentech's view of the importance of patents as typical; it was summarized in its 1992 Annual Report: "Obtained 218 patents world-wide in 1992, for a total of 1,210 patents."

So now let's return to John Behringer's predictions. Did "synthetic" insulin, somatotropin, endorphin(s), and/or interferon ever reach the market? We look at the record. To take just one example, the pioneer company made over $2 million profit in 1992 marketing "three human pharmaceuticals made by recombinant DNA technology for treating four serious medical conditions." The pharmaceuticals: "Protropin," human growth hormone, i.e., somatrotropin; "Activate," which inhibits heart attacks by breaking up blood clots; and "Actimmune," (Interferon Gamma 1-B), for treatment of Chronic Granulomatous disease (GCD), a rare but deadly inherited disorder of the immune system. Further, the company receives royalties under its patents and technology for recombinant DNA products, including human insulin and interferon alpha.

And of course Genentech is not alone. There are now about one hundred biotech manufacturers. Some make final products, some make intermediates needed by other biotech companies. The common characteristic is, nearly all seem to be making money.

And there's icing on the cake: recombinant DNA is reducing unemployment in the United States. Genentech alone has 2,300 employees.

The Mouse

Was the road clear after *Chakrabarty?* No, there was one little pothole.

On April 12, 1988 the U.S. Patent and Trademark Office issued Patent 4,736,866 to Philip Leder and Timothy A. Stewart, assigned to Harvard University. The work had been financed at least in part by E. I. du Pont de Nemours. What was it all about? The inventors had succeeded in inserting a specific cancer-prone gene into a mouse's germ cells immediately following fertilization, with the result that the animal's descendants were highly cancer-prone. Dupont and other chemical manufacturers are already using the rodent's progeny to help determine whether certain drugs are carcinogenic, and in programs to develop anti-cancer drugs. This is, of course, fine, and nobody is objecting to that aspect of animal patenting. But that was about all that wasn't objected to.

Religious groups objected—messing with animals was against the will of God. Maybe man was next! Environmentalists expressed concern that new species would be released into the ecology with unpredictable and possibly dire consequences. (To date, no release and no damage has been reported.) Legislation was proposed to stop all this animal-patenting non-

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sense. (It seems to have died.) Farmers feared the patent royalties they might have to pay on cows that would give more milk, leaner pigs, fatter chickens. They anticipated corporate agricultural patent monopolies that would squeeze out smaller enterprises. (So far, according to an article in *Business Week*, this seems not to have happened.)[11] And see *The New Republic*'s editorial, "What Price Mighty Mouse?"[12] *Time* reports that whole herds of dairy cows are being injected with a genetically engineered growth hormone (BST) for increased milk production[13]; however, we have noted no patents on new and improved cows.

Now, let's back up. The famous and/or notorious mouse patent wasn't a bolt out of the blue. Like an earthquake, it had its premonitory tremors. In April 1987 the Patent Office Board of Patent Appeals and Interferences reversed a rejection of the Examiner and allowed claims directed to a genetically-engineered polyploid oyster. (That's an oyster with extra chromosomes.)[14] The Board relied on the Supreme Court's decision in *Chakrabarty*. (¡Olé! ¡Olé!) And Commissioner Quigg took the occasion to state a policy: "The Patent and Trademark Office now considers nonnaturally occurring nonhuman multicellular living organisms, including animals, to be patentable subject matter within the scope of 35 U.S.C. 101."[15] After this, the mouse was inevitable. And incidentally, let us note that the policy covers not just a mouse, but non-human mammals broadly, from aardvarks to zebras, with platypuses, kangaroos, and whales in between.

At least we're preserving orderly evolutionary ascent. First we patent a bacterium, then a mollusk, and finally a mammal. (Careful there—*non-human* mammal!) And don't look now, but we all know what's next!

The Human Genome Initiative

We have one more stop.

Chapter 24 of the MPEP has close ties to the National Institutes of Health's Human Genome Initiative: 1) the Genome Initiative provides a vast library of citable prior art (mostly through GenBank); and 2) NIH has attempted to patent thousands of its newly sequenced DNA and amino acids. We speculate that, but for the Human Genome Initiative, the birth of chapter 24 might have been considerably delayed.

So let us look at the Genome Initiative.

In the beginning (the mid-eighties) it was called the Human Genome Project, and it was sponsored by the Department of Energy (as successor to the Atomic Energy Commission) to provide information as to genetic change after exposure to radiation.[16]

Goals and support broadened almost immediately. Dr. James Watson (who, with Dr. Francis Crick, discovered the DNA double helix) persuaded Congress to finance a program that would map the entire human genome by the year 2005. This would entail finding the location (i.e., on which chromosomes) of the 100,000 plus genes and determining the DNA sequence of each gene. Cost,

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$1 per DNA base, for a total of $3 billion. About 30% of the budget would go to "informatics," i.e., translating the results into computer-accessible form. The NIH at Bethesda, Maryland was given the project, and Dr. Watson headed the program for several years. He resigned in 1993 and Dr. Francis Collins replaced him.

Comparatively little actual bench work is done at Bethesda. The Initiative funds DNA sequencing research in universities, private laboratories, and by individuals. Overlap is largely eliminated. Several of the individual satellite laboratories specialize in a single chromosome. For example, the Lawrence Livermore National Laboratory concentrates on chromosome Number 19.[17]

NIH has patent rights to any inventions emerging from the program, but if it fails to file, rights revert to the inventors per the Federal Technology Transfer Act—15 U.S.C. §3710d. NIH has in fact filed patent applications on a great body of the work. More on this later.

By the year 2005, if everything works, we should be able to call up on our computers any portion of the Genome. Researchers will be able to design work in genetics that would be impossible at present. For starters, the Genome is expected to enable us to seek out and neutralize our killer genes.

And now to—

Chapter 24

The MPEP's chapter 24 is divided basically into two parts. The first part (the Deposit Rules, §§2402-2411.05) deals with the question of whether and how the applicant has to deposit a sample of his new bio material. (According to MPEP §2403, ". . . the term biological material shall include material that is capable of self-replication either directly or indirectly. Representative examples include bacteria, fungi including yeast, algae, protozoa, eukaryotic cells, cell lines, hybridomas, plasmids, viruses, plant tissue cells, lichens and seeds.")

The patent statutes require that the public has to be able to carry out the invention after the patent expires. If this operation requires access to bio material mentioned or claimed in the patent, and there is no other way to get the material, then the applicant must deposit an immortal specimen in one of the standard depositories. The MPEP lists a couple of dozen, in various countries. (There are three in Moscow, one in Bratislava, one in Seoul, and so on.) Samples of the specimen must become available to the public when the patent issues, and prior to issuance under certain conditions. (For example, the mouse patentees duly made their deposit in the American Type Culture Collection, Rockville, MD. No, not the whole mouse—just the plasmids bearing the fusion genes.)

The Deposit Rules have been basically in existence in one form or another for several years, and their inclusion in chapter 24 is mostly fine-tuning. The "point of novelty" in chapter 24 (to use patent lingo) is the second part of the chapter, §§2420-2433, the Sequence Rules.

The Sequence Rules are directed to

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inventions involving DNA sequences and/or amino acids. The sequence of the invention must be presented in computer-readable form, either in tape or diskette, using IBM or Macintosh computers. Additionally, the sequence must be submitted on paper in printed form. Standard symbols are required, e.g., A for adenine, C for cysteine, N for unknown, Ala for alanine, Arg for Arginine, and so on. A DNA invention must state at least ten nucleotides, unbranched. An amino acid invention must define a sequence of at least four L-amino acids, unbranched.

So the tape comes into the Patent Office. Now what? The examiner puts the claimed invention to the three statutory tests: Is it new? Is it unobvious? Is it useful?

For novelty, the examiner checks the "computer-readable" material against one or more DNA/amino acid libraries. GenBank, sponsored by the National Institutes of Health is probably the most comprehensive. The Patent Office even offers a program (Patentind), on four disks, supplemented by live classes in Washington, D.C., on how to search the prior art in preparing a DNA sequence patent application.[18] Also, useful information on how to make a DNA sequence search before filing an application is provided in various articles. That by David J. Aston is typical.[19]

Let's say the Examiner finds that the sequence is literally novel, but is quite close to a sequence already of record in GenBank. In fact, let's say it differs by only one nucleotide. He rejects the invention as obvious. And here the fun begins. The inventor, with the help of his attorney, will have to find arguments sufficient to convince the Examiner that the difference is unobvious. Sometimes the inventor will be able to show that a tiny change in an otherwise routine sequence will produce an unexpected result. For example (but negatively speaking) 574 amino acids make up a molecule of hemoglobin. But change just one—replace valine with glutamic acid—and you get a sickle cell. Similarly, HPRT, an enzyme containing 217 amino acids, is essential to metabolize purines which would otherwise build up to toxic levels. Change one guanine to cysteine, and the seventy-first amino acid from the end of the protein will be arginine rather than glycine, and the enzyme won't work, and death results. The usual rules of homologs (you claim methyl, the prior art shows ethyl, you're dead) and analogs (oxygen equals sulfur) available to the patent examiner to reject routine chemical patent applications may prove totally irrelevant for genetic cases. It's a different world.

Finally, is the claimed sequence useful? Its mere existence is not enough to prove utility. Nor will a generalized statement do. It has to perform some act of value to something or somebody. Will it help degrade oil spills? Is it a precursor in making insulin? As we leave the applicant with his problem we are reminded of a research team in a well known corporate lab. They were making new nitrogen compounds, structurally exotic but with no

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known real utility. Unpatentable? Not at all. Because of the nitrogen content they made fine fertilizers (at $500 a milligram). A statement of this specific use satisfied the Patent Office's utility requirement.

Utility (not to mention novelty and unobviousness) may be a special problem for the NIH and its efforts to patent the first several thousand DNA sequences resulting from the Human Genome Initiative. There was internal argument at NIH as to whether such a comprehensive patent program should be undertaken, and it was finally begun because under the rules of employment, the discoveries could otherwise be patented by the inventor-employees. Also, similar programs were already underway in foreign countries, particularly in the United Kingdom. Biotech producers in the United States are understood to have similar patent programs (though more limited) and presumably will face similar problems. With its 7 automatic DNA sequencing robots and 45 computers NIH is attempting to stay ahead of the pack. Commentators have already zeroed in on some of the prosecution difficulties expected for the NIH patent applications, especially as regards utility. Basically, NIH argues that the opportunity for further research is sufficient recital of utility for their DNA sequences. This argument was rejected long ago by the Supreme Court in *Brenner v. Manson*.[20] An article by Stephen B. Maebius outlines some of the problems that may affect NIH.[21] Indeed, it has recently been reported that the Patent Office has rejected NIH's applications as lacking a showing of utility.[22] The future of the NIH patent program therefore seems clouded; however as long as we have creative patent attorneys with willing clients, we should not consider the patentability of DNA segments as totally dead.

The DNA sequences NIH sought to patent were derived from the human brain.[23] If these or similar patents ever issue, some further fascinating problems may arise. Query: since a patent covers making, selling, and *using* the invention, will our use of the patented sequences in our normal mental processes constitute infringement? Or would the patent cover only certain types of thoughts? How about dreams? (We're in quicksand here!)

Having got his DNA sequence into the patent mill, does our inventor (again, we mean his attorney) stop there? Not necessarily. He has filed for a routine chemical patent. Maybe it will issue, maybe it won't. But it's only one bite at the apple. Is back-up protection available? (Now, remember the motto of the firm: *Carpe Diem*, or, "Look for billable hours.")

He looks at the DNA sequence, an almost interminable string of printed capital letters. Can he copyright it? Certainly worth a try. Protection for the life of the "author" plus 50 years. Very nice. Anything else? Visualize the DNA in three dimensions. Good material for a design patent, with a life of 14 years. MPEP, Chapter 1500, describes requirements for a design patent. And how about a trademark? A trademark is forever! According to

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§1512 MPEP: "There is an area of overlap between copyright and design patent statutes where the author/inventor can secure both a copyright and a design patent. . . ." ". . . A design patent and a trademark may be obtained on the same subject matter." We are now looking at a Caribbean cruise. Anything else? Check the rules for plant patents, Chapter 1600, MPEP. Can we add a week on the sands of St. Maarten?

The Future

What does mid-century hold for bio-engineering, in and out of the Patent Office? Mostly it looks good, but there may be some problems.

The government will have a lot more control over us. A specimen of our DNA will be taken at birth and filed away, along with our birth certificate. The depository will be bound by law to keep it confidential except by your permission; but you know how these things work. Insurance companies, employers, schools, your bank, credit agencies, your therapist, courts, judges, all branches of government (federal, state, municipal), maybe even your neighbors, will have access to it, legally or illegally. You will be judged for your *tendencies* before you ever commit an antisocial act. We anticipate a fair amount of blackmail and dirty politics. But take heart. Isn't life pretty much that way right now?

Let's move on to pleasantries. Spielberg's techniques in *Jurassic Park* will be verified for all sorts of scenarios. We'll clone the Iceman and/or his cousins, Egyptian mummies, and of course, ourselves. All this will be enormously facilitated by symbiosis with computers, which can sequence hundreds of thousands of codons per second and instantly synthesize the read-out from squirts of the requisite DNA bases. There's a lot of patentable subject matter here!

The Patent Office will churn out patents on new genetic products and new genetic processes, many of them tied to computers. Computers will make to order synthetic clonable genes with specific (hopefully beneficial) end uses. Entire chromosomes will follow. Can "synthetic" ova and sperm be far behind?

Yes, we're going to redesign *people*. The goal is not new; the difference is by 2050 we'll have the technology, and we'll be using it. We'll be in space in a big way. We'll need men and women with bodies especially adapted to the low gravity of the Moon and Mars, and for long interplanetary voyages of zero gravity. For the rest of us, we may need new genes to help us deal with radiation, excessive UV, smog, and general atmospheric and terrestrial pollution. Actually, the list of genetic possibilities is almost endless. We'll probably be able to implant genes for enhanced IQs, say 150-200. And we can aim at musicians with perfect pitch, world-class artists, athletes, writers, businessmen, chess grandmasters. Can we design a saint? A demon? Would we want to?

Are these modified people patentable as manufactures and/or compositions of matter under §101? Patent Commissioner Quigg sternly warns

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us, "A claim directed to or including within its scope a human being will not be considered to be patentable subject matter under 35 U.S.C. §101. The grant of a limited, but exclusive property right in a human being is prohibited by the Constitution."[24] We hear you, Commissioner. On the other hand we foresee enforcement problems. The U.S. Constitution doesn't apply to slave-owning societies such as Sandy-Iraquia, or, for that matter, even to off-shore laboratories. If a sheik brings in a bio-engineered "slave," does he forfeit ownership when he crosses the borders? Shades of Dred Scott! Actually, the commissioner himself points the way out of the dilemma, at least as far as the Patent Office is concerned. ".... It is suggested that any claim directed to a non-plant multicellular organism that would include a human being within its scope include the limitation 'non-human' to avoid this ground of rejection." At Immigration the sheik explains, with a sweeping gesture toward his harem, "They're all non-human."

By this simple distinction, various characters in film and fiction would have been patentable and subject to ownership by somebody, viz., The Bionics (Man, Woman, and Dog); Robo-Cop; Terminators I and II; the replicants in *Blade Runner*, and so on.

In this future bio-engineered world we'll probably go in for eugenics. Very likely we'll be able to detect and destroy flawed embryos within a few days of conception. Of course, what constitutes a flaw will be open to argument.[25]

We can expect the medical field to continue in the forefront. This was the original economic incentive and it seems likely that the need will continue indefinitely. Diseases caused by faulty genes will have a high priority. These might include cancer (in its myriad forms), cystic fibrosis, Down's, hemophilia, adenosine deaminase (ADA) deficiency, and several dozen others. There may also be hope for schizophrenia, depression, alcoholism, and other mental problems. And diseases such as AIDS, though not hereditary, may yet be helped or cured by genetic manipulation. And note that Down's disease (mental retardation) is caused by an extra No. 21 chromosome. Will some future Nobelist tell us how to deal with this genetic hazard in the newly fertilized ovum?

A major problem in gene therapy has been getting the correct DNA into the system. Standard procedures include use of a "retrovirus"—a specialized clonable virus consisting of a strand of RNA—with the ability to find its way to the targeted area. For treating cystic fibrosis the adenovirus is used; it causes the common cold and obligingly heads straight for the lungs. In another technique genes are placed in bubbles of fat (liposomes), which then hopefully find their way to the proper body cells. We can look for patentable inventions in these areas in the future.

At the moment bone-marrow transplants for adenosine deaminase (ADA) treatment look very promising as a means for getting the desired DNA to the spot where it is needed.

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ADA is a key enzyme; without it the immune system cannot function. In this technique stem cells are taken from the patient's bone marrow, healthy adenosine deaminase genes are inserted into these cells, and the altered cells are returned to the patient's blood stream. Successes have been cautiously reported.[26]

We have every reason to believe the bio future holds some marvelous things for us, not only solutions to problems mentioned here, but also some benefits we cannot even imagine today.

And so, after chapter 24, what?

Will the present emphasis on biogenetics continue into the next generation, or will it fade away with the dramatic inventions of yesteryear—synthetic rubber, the high-molecular weight polymers, penicillin and other "miracle" antibiotics, electronics (radar, especially), DDT and other remarkable insecticides, embryonic TV circuits, automatic gear shifts, the new aerodynamics of jets and helicopters, and of course the whole nuclear area.

Today we look back at these things, and the excitement is hard to remember. The nuclear stuff is still hermetically sealed. The rest is commonplace. Many of the once-magic insecticides are now known to kill birds and fishes and to cause cancer. Microbes have developed immunity to many of the once-revered wonder drugs. TV and the rest we pretty much take for granted.

Will genetic engineering suffer the same fate? By 2050 will recombinant-DNA and gene transplants be buried in dusty patent files along with DDT formulations and LP-record players?

NO!

And the reason is, despite all the marvelous work and research already done in the field, biotech is still in its infancy. So far we have seen only the *tip* of the tip of the iceberg.

And of course the Patent Office will be there, in the middle of all the flowering technology, and enjoying every minute of it. We await the hypothetical case of *Jones, Commissioner v. Pseudo-homo,* involving patentability of the first completely synthetic human being. (Actually, old stuff in science fiction, even as to patentability.[27])

Lawyers, *Carpe diem!* ■

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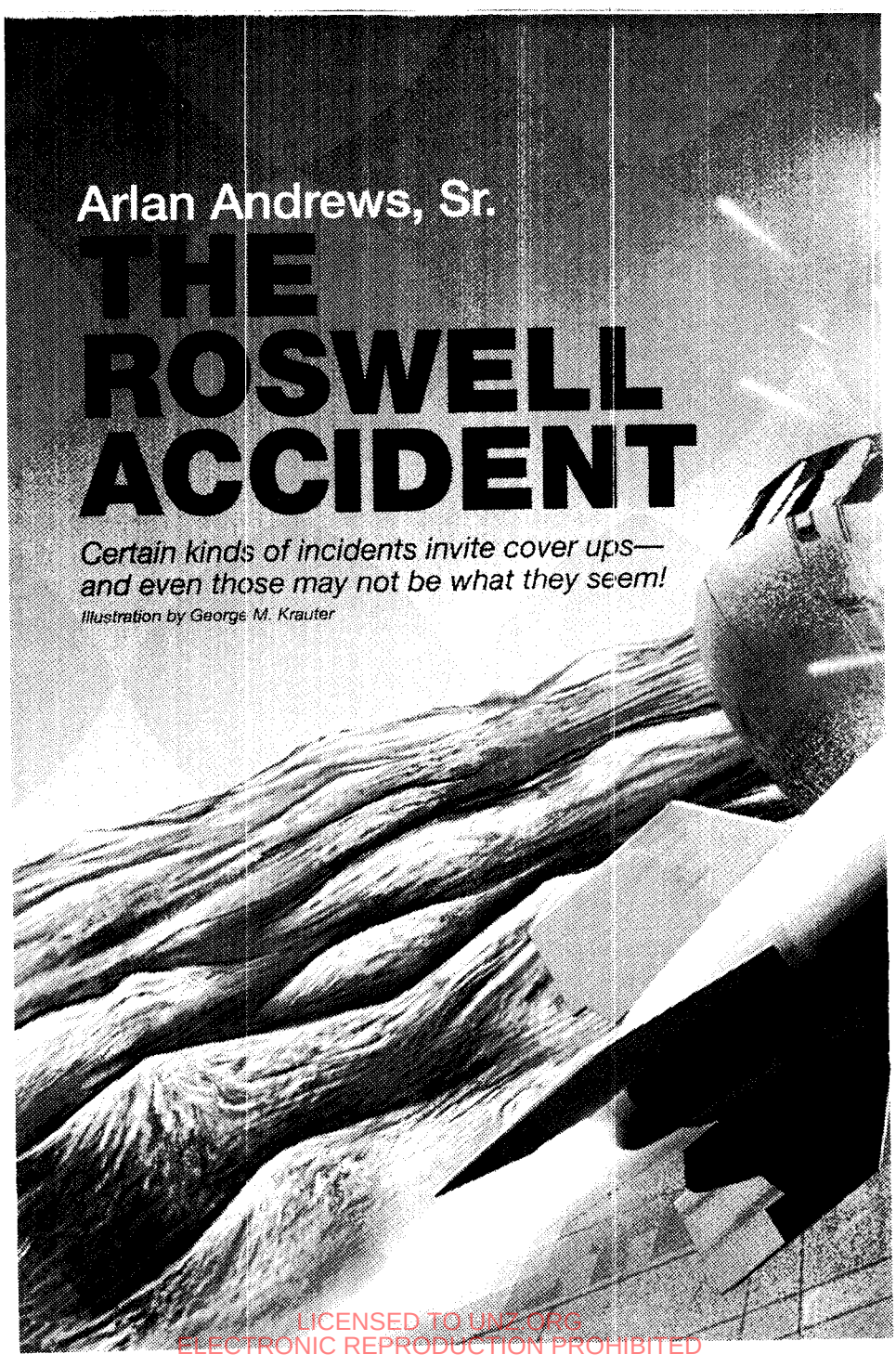
Arlan Andrews, Sr.

THE ROSWELL ACCIDENT

Certain kinds of incidents invite cover ups—and even those may not be what they seem!

Illustration by George M. Krauter



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It was *sweat* that finally brought up the subject of Roswell and what really happened there in 1947.

The bar was one of those low-lit, low-rent holes-in-the-wall you can still find in the non-yuppie parts of Las Cruces, part cowboy-redneck, part Chicano, a sort of neutral watering-hole where the two cultures met and mixed in an uneasy, alcohol-blurred truce. And so it was that Francisco Herrera Silva—"Frank"—and I were sharing an easy New Mexico afternoon savoring the cool darkness together, sipping beer and telling stories, yet overshadowed by a stratum of incipient sadness. I had met this man nearly forty years ago, when I was a co-op student at White Sands Missile Range, but I had been gone a long time, working on, let us say, "other areas of interest." Last week he had called with news of his bad heart condition and I hurried back from Washington for what we both knew would be our final meeting. Frank was very important to me—and potentially, for other reasons, to others in my agency.

Picture Frank Herrera, descendant of Conquistadors and Indian warriors: skin the texture of greasewood, dark and scoured after a lifetime of working as a missile tracker in the hot, bright, high desert that was the missile range on the other side of the lunar-like Organ Mountains twenty miles to our East. Skinny as a rail even after seventy years of tortillas, frijoles, and cerveza. "It's them *jalapenos*, Andy, the Hatch specials, they keep you in good trim." I said I thought that genetics had something to do with it, too—in the days before air conditioning fat people couldn't live in the desert. They simply died; I guess it had something to do with the fact that volume is dimension cubed, skin area is dimension squared, so they couldn't sweat fast enough. Anyhow, it was me explaining that conjecture to Frank, how sweat brought up the topic of what happened in Roswell, fifty years ago.

"Andy," he said, "speaking of sweat out here on the desert, I've been sweating something a long, long time." I felt my pulse race; my search for the truth might be nearly over. "I've been retired ten years now, you know. Doctor says my ticker is about out, I could go at any minute." I nodded, slugging down more beer to calm my nerves a bit. "Somethin' I always wanted to tell you, but couldn't back then. You know how it was, security and everything." Acknowledging my nod, he continued.

He hesitated a moment, grimacing as though his heart might be giving out right then and there. I was afraid for him, but in an instant that familiar old smile returned and he reached for his beer mug. "In those earliest days," he said, "there was sometimes only one launch per week, maybe per month, so we trackers had a lot of time on our hands—we used to hang out with the launch crews." Sometimes they were even called upon to help with the launches themselves, short-handed as the army base was then, especially for trained electronic-optical technicians like Frank. "That's when I met the Germans, you know, those Paperclip dudes."

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I nodded again. "Operation Paperclip" was the Army's cover name for bringing over the entire infrastructure of the German V-2 program—rockets, parts, engineering drawings, special machine tools, even the scientists and engineers that the Russians hadn't grabbed first.

His eyes met mine, his face drawn tight. "Andy, I've gotta tell you. We shouldn't have shaved the monkey. I'm sorry I ever suggested it." Gently I set my empty mug on the table, fighting back the urge to choke up and spit it out. So Frank actually had been a *participant* in the Incident Scenario? I managed to swallow the mouthful of beer and let loose a sigh. He frowned. "You know about the monkey, Andy?"

Lying, I shook my head. At that moment, I knew the Roswell Incident was coming up.

You might've heard of the so-called "Roswell Incident." Back in July 1947 a rancher near Roswell, New Mexico, found some unknown material debris on his property, like a busted up aircraft of some kind. The story goes that something strange had been flying across the desert in a thunderstorm, then crashed on the man's property. The unsuspecting discoverer took some of the pieces in to the sheriff at Roswell and then all hell broke loose.

Seems like the world's only atomic bomb squadron was located at Roswell Army Air Force Base, and the military was really sensitive about unknown aircraft flying nearby. All kinds of military people flew into Roswell in a hurry, went out and scoured the "crash site," then toted all the stuff away. Many stranger things happened back in Cold War I, and you never heard of them, probably never will. This incident, too, should have been kept quiet and would have, except that when the sheriff called the Army Air Force base, he mentioned the pieces were probably from a flying saucer. The headline the next day—all around the world—read "Army Recovers Crashed Disk Near Roswell."

Immediately the pieces were flown elsewhere, and the Army Air Force had a press conference showing pictures of a weather balloon. Given the mood of the country in those days—fifty years back, you recall, most Americans still trusted their government. After all, this *was* before Dallas, Vietnam, Watergate, the Lake Affair and the Bessarabian Event; for the most part, back then, when the government said forget it, people forgot and went on about their business. But in the Eighties, the whole Roswell thing was resurrected, dusted off, and became a cottage industry for the down-in-the-financial-dumps "experts" of the all-but-defunct pseudoscience of flying saucers. For kickers, they added little dead gray aliens to the crash scene!

To the uninformed citizen, there was a rough kind of "logic" to all this, especially if you believe in Big Government Conspiracy: "The government found a UFO and has kept it for fifty years. Fifty years of lying to us about the existence of alien beings."

You get the picture—fifty years of

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cover-up, lies and deception, all stemming from "The Roswell Incident." What a waste of energy; shows you the depth of paranoia against the duly elected officials of the government. To me, it means there are too many people with too much time and money on their hands and not enough actual work in the real world to keep them off the streets and out of trouble.

That's "The Roswell Incident," in a nutshell. Accent on the "nut."

Frank continued on, about shaving the monkey. "Andy, these Germans, they had to stay on the base so they got kind of lonely, know what I mean? I even wound up teaching them English." I laughed aloud at the picture of stiff German scientists and technicians learning English from a Chicano with a decidedly border Spanglish accent. Back then, while they were inventing the future, I would have been only about seven years old, hadn't yet read any Heinlein, probably still thought of rockets as the Fourth of July kind. "I helped them work out the paint pattern so we could measure yaw, pitch and roll, the missile attitude, from the film images from our tracking cameras.

"But, Andy," his tone dropped and his eyes sought out every person in the uncrowded bar, instantly evaluating their status, the "yaw, pitch and roll" of their body language, an analog to the missile tracking parameters he had spent most of his working life concerned with, "It was those younger Germans I was working with, when it happened."

I smiled. "Go ahead, Frank. When what happened?" I was dying to know about the monkey.

"Guenther and Heinz were their names, their first names. After all this time, I don't remember their last names—long German names, as long as 'Schikelgrubergratz,' names like that. They had originally signed on under von Braun during the war because they thought that rockets would take mankind out into space, you know, the Moon and planets."

My third mug of beer was taking hold, and I enjoyed the mellow feeling. The leveling drug I had taken before meeting Frank today would keep my blood alcohol at precisely this level, no matter how much more I drank. One of the nice perqs of working at—where I work.

"Them Germans wanted to get into space in the worst way, and they figured that our country, being the victor over theirs and all, was rich enough to afford it. So one day in the fall of 1946, I believe it was, we were sitting and drinking some great German beer in the O-Club on base. We start talking about this idea to find a monkey, shoot it up a hundred miles on top of a V-2, bring it back by a parachute on the nose cone compartment, and then tell the world about it, and get us all excited about sending a man up there, too." Frank said that the Germans themselves had gotten really excited once back in the 1930s, when their press reported one of their guys had been inside a rocket that went up fifty miles. Turned out to be a hoax, but millions of Germans remembered the excitement. Guen-

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ther and Heinz, they wanted to recreate that sensation over here in New Mexico, get Americans just as excited, and get started toward the Moon.

"Heinz, he really wanted to go up on the V-2 himself, right away, but they couldn't guarantee recovery; German parachutes hadn't worked all that well, and as much as he wanted to go, he didn't want to die so soon. So we came up with the idea of borrowing the monkey."

A retired NCO in the nearby sleepy village of Alamogordo had built a little bar on the main drag, got hold of some exotic animals, and was putting together a small zoo for the patrons. Frank had never seen the connection between alcohol and animals, but the zoo was a-borning. And the star attraction was the monkey. The chimpanzee looked to weigh about seventy-five pounds, when the three went for a visit to the bar, and in that very bar they plotted mankind's future in space. (I should put in here that I know a *chimp* isn't actually a *monkey*, but you get the picture and I wasn't about to interrupt Frank, not when I was finally onto the truth.)

"Heinz said that the monkey should be put in a space suit. Paperclip had brought over some high-altitude suits, from their jet-airplane projects and they would cut one down to size." So, Frank continued, he and the two Germans plotted the kidnapping and the subsequent launching of the chimp in the forward section of a V-2. "The Germans, Andy, they whipped up a kind of pancake-shaped contraption that fit into the base of the nose cone of the V-2, to substitute for the real instrument package. The rest of the pointy section was a parachute to bring it and the monkey back safely. Just slide him down into a slot and tie him in. They just had a couple of inches on each side of him where they were going to put in a lot of mohair padding just in case it was a rough ride."

It hadn't worked out quite so simple; then again it never does in the real world, unlike the way those super-techies on TV do it.

"Real early on the morning of the launch, we did grab the monkey just like we planned, out of the cage just after the bar closed in Alamogordo. A little chloroform from the Germans' dispensary did the trick real good. I drove that little *chingaso* back to the range with Guenther there to hold him down if he woke up. Back at Launch Area One, Heinz had arranged with the launch director to make a 'final inspection' of the V-2 instrument before it was erected. Originally the other scientists were going to do a barometric atmospheric instrumentation drop—letting a package fall out of the V-2 when it reached its peak altitude of about a hundred miles, measuring the air pressure and temperature all the way down. It was the planning for that mission that had given my Germans the idea about the monkey in the first place.

"At the last hour somebody apparently tried to scrub the launch, but Heinz and Guenther went to von Braun and Durrenberger and some other high mucky-mucks and convinced them to go ahead. In those

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days you didn't need an act of god-damned Congress to launch a scientific rocket experiment, and it only took a dozen men to set it all up anyhow. Whatever they said must have worked; I never have been sure if it was even an authorized launch, now that I think back on it, but I didn't concern myself then with that kind of stuff. All I knew, it was working out like we wanted. My Germans even made sure I was going to be part of the set-up ground crew, and that's why I was allowed in.

"Well, we took our wrapped-up monkey to the tent where Heinz was. And that's when the trouble started." Frank swallowed a long draught of beer and wiped his mouth on his forearm. God, but his eyes twinkled, his mouth and those hundreds of dark wrinkles forming up a smile that involved summing the complex topologies of all the muscles of that inscrutable face. "That's when the trouble started, Andy. God, what a mess!

"That monkey wouldn't fit into the cut-down space-suit, was the first problem: he was hairy and the suit was rough and they couldn't get him into it. And, even if he did, they saw that he wasn't going to fit into the slot in their pancake package. They jabbered something about English and metric units, but whatever it was, they had screwed up pretty bad and were going to have to cut the chimp down to size or re-do their pancake pilot's compartment, and so either way they would get caught. They had put the trimmed-down altitude helmet on the little guy, and they were trying to put the suit on it when the critter woke up." He chuckled and that smile continued its way around his whole face, his squinting eyes fairly disappearing behind his upraised cheeks.

"There we were—just a couple of minutes to 'inspect the instrumentation'—with a wild monkey screeching and screaming, flailing away at the Germans and doing his best to get out of that suit. And no way were they going to be able to stuff him into that tiny torture chamber. We're inside a little tent barely big enough for three men, that covers us and the V-2 nose cone portion. The tent was for protecting the instruments and things from all the sand and trash that blows around the desert in the early mornings. You know how that is, over on the Range." Remembering the wind effects vividly, I smiled broadly.

"Anyway, with the wind whipping the tent flaps and the monkey screaming and the two scared Germans yelling at each other for screwing up the chimp pilot's door, I started laughing out loud. The Germans turned to glare at me, and the monkey calmed down, too. That's what I said, 'Hey, Alemans'—that's Spanish for 'Germans'—'Hey, Alemans, why don't you shave the little *chingaso* naked,' and Guenther, he goes to the blockhouse to explain that a barometer recorder or something is on the fritz and will take a couple minutes longer. My idea worked pretty good. Only thing was, the grease we used to pack the naked monkey in, was a kind of instrument grease the Germans had brought over in Paperclip stocks, a gray gooey stuff. We were able to slide the little dude

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into the suit, and get the instruments hooked up to him.

"Boy, did that poor creature ever look strange; four feet tall, jammed into a too-small suit with a jerry-rigged"—Frank laughed at his unintentional pun—"space helmet on him, and wires dangling all over, hooked into the on-board wire recorders and some radio transmitters. Barometric parameters!"

"So how'd it go," I asked, "the launch, I mean? And the recovery?"

Frank shrugged. "I went back to my station, one of those little mobile jobs, a single-man kind with the twin telescopes. Tracked that sucker up and over and out of sight, right at dawn. She lit up the sky something fierce, perfect for a couple miles up." He frowned. "Then something fell off, twisting and turning down and I had to track that piece. My assignment was to record unusual events. Other stations tracked the V-2 itself."

"That was the morning of July 7, 1947?"

"Yeah, Andy, the one they later said never was launched. But it was. And the monkey went up with it."

I studied Frank's face in the darkness, illuminated by the reddish neon on the wall above us. He was telling the truth—*As he remembers it*, I told myself. *But then, that's all any of us can ever do!* "You ever find out what happened to the monkey, Frank?"

"Nah, Andy, not really. I heard some Army guys and a German say later that it might have crashed near Roswell, but that was when the 'flying saucer' scare went on over there. I didn't know if the two were the same thing or not, figured I'd better not say anything. I was just starting at the Range and didn't want to lose my job, maybe go to jail for screwing with government property. Of a sudden, it didn't seem like such a good idea." The front door opened, a sliver of white desert light shot briefly across Frank's dark face, revealing a semi-serious expression that faded quickly back into the darkness of eclipse. "Hell, now I'm retired, just about dead, and I read about the 'Roswell Incident,' and I figure you ought to know what we did back then. Now I know, it had to be the same thing. After all this time, had to be."

He went on to tell a rollicking version about how the pancake contraption probably popped out of the V-2 nosecone, parachuting itself and the chimp pilot to Earth. "Can you imagine, Andy? This old rancher goes out there, and he sees a goddamned 'flying saucer' on his ranch? He hears some screeching and hollering inside, opens up the handy-dandy knob on the door and a wild-ass greased monkey, scared shitless and tearing off its space suit, jumps out, dangling wires and cables and runs off into the desert?"

I laughed so hard the tears came. "Frank," I finally gurgled out, "you should have been a stand-up comic, this story is funnier than hell!"

"So, Andy, this rancher guy takes a piece of the compartment to the local sheriff, and an Army Air Force guy hears the description of the craft, and pretty soon they are all convinced they've got a 'flying disk' out in the desert. In the meantime, since it's so

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near the world's only atomic bomb airplane squadron, a couple of investigators go out and find that it does look like a disc, but it's made of some German parts and some White Sands parts, and so they freak out.

"All I know for sure is Heinz and Guenther don't show up any more around the Range, and so I take the hint and stay away from all Germans." He smiled once more, the beer and the confession flushing out his relief. He'd lived with the story fifty years and now it was out, and he felt a lot better for sharing it.

"Tell you what I'd do Frank," I said in a conspiratorial tone, "I'd write it up, just like you told me, and sell it to *Reader's Digest* for five or ten thousand bucks."

His beer mug gently sank to the tabletop and his mouth dropped open. "Andy, you think they'd take it? And *pay* for it? That *much?*"

"I'm sure of it, Frank," I said cheerfully, and I was; and the editor there owed me a big favor. Hell, the story would have sold on its own merits, but timing and contacts and expediting are everything in my job. "It'll be a hell of a splash! And you'll put some of these UFO nuts out of business."

Calling a cab to take him home, I guided a happy and inebriated Frank to the front door as we said our last goodbyes, and he promised to write the story. I would make sure of that, I said, and at this moment I have an Agency person transcribing his side of the story into a salable narrative form. Tomorrow I'll deliver it to Frank and he can send it in with the pre-paid Fed Ex envelope I'll give him, and in a week he'll be ten thousand dollars richer and in two months he'll be notorious worldwide as "The Man Who Hoaxed The Roswell Incident."

If his heart holds out, there'll be appearances on Letterman, Montel, Oprah, and Sally Jesse, plus a contract for a book-length version, and serious inquiries by two very famous West Coast sci-fi movie producers. We want Frank to succeed; we will *guarantee* that he succeeds. Believe me, his story *has* to be told until everyone on Earth believes it.

After all, Frank is a very important person, maybe the most important person in the world, and this project has been in the making for half a century. Even my original, innocent friendship with Frank had led to my own recruitment by the Agency. It had taken some brilliant foresight by Donovan and the others who founded the Agency in that same momentous year of 1947, to decide to leave Frank alone after they finally believed the Germans' stories. His final testament would be all the more believable, although we'd have to edit out a lot about Heinz and Guenther. Those two, non-citizens and members of a recently-hostile weapons group, hadn't survived their interrogation and solitary internments at Leavenworth.

Alone with my thoughts and the micro-camcorder that had documented the entire interview, I sat thinking over Frank's story. It was all true, but it was not true enough. The space-monkey business *was* an excellent idea, and under other circum-

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stances could have opened space up to us a lot sooner. Heinz and Guenther and Frank would have been world-wide celebrities back in 1947 and we could have had men on the Moon ten or fifteen years sooner. But I still don't know if we would have given up space travel that much sooner, too.

But I *am* sure that they changed history, all the same.

Because in the agency I represent, it's our business always to know the rest of the story. And that story is this, I tell myself, because only ten of us know and we can never tell anyone else: In June of 1947, a radio message was received directly at the White House main radio-receiver—the one used for highest-rated secret encrypted communication—and nowhere else; it was beamed that tight, something not possible with human technology of the day. The communication stated that interested parties from off the Earth were coming to visit the United States. From their star system—unspecified—they had witnessed the atomic bomb explosions in 1945 and were en route to discuss matters of mutual interest. They would make themselves known to the government in several fly-by displays of top-secret installations, and then they would land in secret at the most secure facility in the country, in all the world. That was the Army Air Force Atomic Bomb Base at Roswell, New Mexico.

Through a screwup, the V-2 launch crew never got the word to stop all activities. (Or maybe, now that I know Frank's story, the reason is clear why they launched.) The aliens—whoever they were, wherever they were coming from—must have seen the rocket being launched just as they were descending. They apparently took it as a threat and flew in close to inspect it or, I suppose, zap it out of the sky. But even aliens are kind of human, I guess, because somehow they screwed up and smacked into the V-2. Our eyewitnesses were all confused about exactly what happened, but the two craft did impact, probably a glancing blow.

We figure that most of the V-2 disintegrated in the crash, even though part of the monkey compartment survived. *That's* the stuff the rancher picked up and took in to the sheriff, starting the whole crashed flying saucer business. I still can't find out what happened to the monkey, but that's not important. What *is* important is that the alien ship was hurt, too; I guess that much deceleration, a huge crash at thousands of miles per hour—no telling how fast the aliens were going—was enough to kill even high-tech interstellar visitors. So that rancher's reports and all the rest of the weird stuff surrounding the "Roswell Incident," it happened, too, but not right there and not like the "researchers" believe. It's kind of humorous, occasionally, to think that a false report could have started all the ruckus, and that the real crashed saucer was some distance away and never reported. But recently some too-inquisitive amateur UFO researchers apparently got onto something like the real story, and too many books were getting too close to the

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truth, and we had to squelch it once and, hopefully, for all. We can't let any other nations know what we've got, even if we can't use it, not with the bubbling instabilities of the clandestine Cold War II about to split the international scene wide open.

So the damaged saucer with its dead crew landed nearby, apparently on automatic, and fortunately for us, a door popped open, whether by accident or design we will never know. Not that getting inside the ship helped us at all. You see, although we picked up the spacecraft and its crew of little gray men, in fifty years we haven't been able to find out anything about their technology. Literally, we can't even scratch the surface of any of their materials, and the alien space suits are the same. We can't even get into the space suits to autopsy the little gray guys! And no, they haven't rotted.

In other words, we haven't learned a single damned thing, in all this time. Not that any other nation—or our own public—would believe us.

We've been waiting for fifty years for another contact, so we can at least say we're sorry and would they like to try again, please, but they haven't said anything else at all. Not so much as a radio message, even though their craft still buzz our nuclear bases regularly. Are they looking for their people or what? We don't know what their crew reported back home before the V-2 crashed into them; we don't know if they're pissed off out there or what. For obvious reasons, we never told any other countries about this, and sure don't want them to find out now, after all this time, not in the shape CWII has got us into. So we've got to kill any and all rumors of crashed vehicles from space, and Roswell was *Numero Uno* on that list. Now I'll be able to squelch it for good, with Frank's hilarious revelations about the Space Monkey of 1947.

But I'm not laughing. If Frank and the German's *hadn't* tried their misbegotten monkey experiment, if that V-2 hadn't been launched, if it hadn't killed that alien delegation, no telling where we might be traveling today—Alpha Centauri, maybe, or out in the Magellanic Cloud. We just don't know, even though the Agency has people studying possible alien psychologies. I don't even understand some humans very well; I'm afraid aliens might be even weirder than we can imagine.

But surely *something* is going on with those guys out there. Even for aliens, fifty years is a long time to hold a grudge, don't you think? ■

A man who doesn't respect his own work shouldn't be allowed to do it.

—Kelvin Throop

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IT'S ANLAB TIME AGAIN—PLEASE VOTE!
Your ballot will be automatically entered in our drawing for a free one-year subscription!

Mid-December is our last issue for 1994, and as usual we're asking you to help us via The Analytical Laboratory. Not only will your votes provide tangible rewards for your favorite authors and artist, but your feedback will help guide our selections of what to offer you in the future. Your vote is important!

Look over all your copies of *Analog* dated 1994, or refer to the annual Index which will appear in our January 1995 issue. Pick your *three* favorites in each of the following categories: novella or novelette (a single category, for AnLab purposes), short story, science fact article, and cover. If you're not sure about a piece's category, you'll find it listed in the Table of Contents for the issue in which it appeared, as well as in the Index. List your choices in order of preference (your favorite in each category is #1) on the ballot below, and mail it in. The ballot is intended to make it easier for you to vote, but if you don't want to cut it out, feel free to copy it.

Please send your votes to:
AnLab, *Analog,* 1540 Broadway, New York, NY 10036.

To be sure your vote counts, please mail it in time to reach us by February 3, 1995.

Thank you very much!

NOVELLAS & NOVELETTES

1. _____
2. _____
3. _____

SHORT STORIES

1. _____
2. _____
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Jerry Oltion

FERMAT'S LOST THEOREM

If this story seems familiar, there's a very simple (but hardly mundane!) explanation. . . .

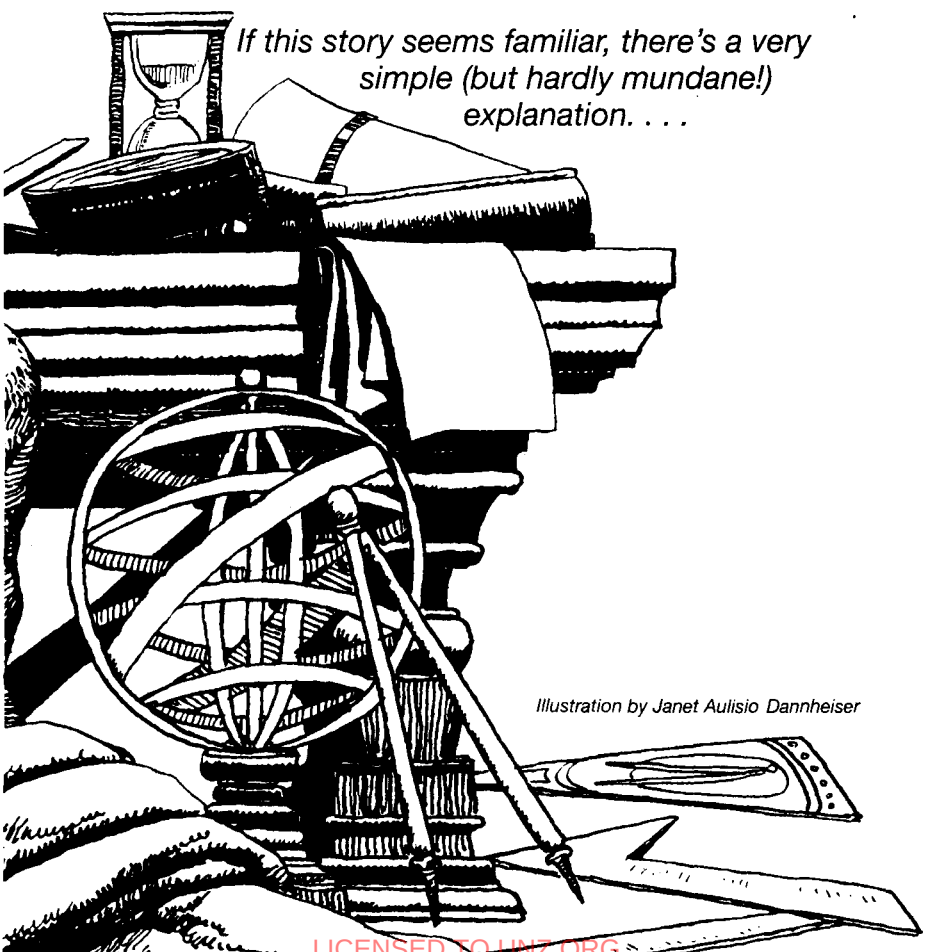

Illustration by Janet Aulisio Dannheiser

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When Rick Hopkins met the new math professor, he felt the sudden conviction that he'd slept with her. Trouble was, he couldn't remember when.

The faculty lounge was abuzz with people milling about, cocktail glasses and colored napkins in hand. Marsha Selwood stood amid a small knot of professors and assistant profs near the punch bowl while Vince Gardoni, the department head, introduced her around. Tall, blonde, with high cheekbones and green eyes, she would have been the center of attention even if she hadn't been the guest of honor. The only people in the room who weren't fawning over her were the other women, and the dozen or so grad students who hovered over the hors d'oeuvres, nervously packing away rumaki and canapés as if they were french fries. Rick didn't recognize half of them, but he supposed their formal clothing accounted for that. Put them in baggy jeans and flannel shirts and they would suddenly become familiar again.

Maybe that was the problem with Marsha. Rick must have met her under different circumstances, and he just wasn't making the connection.

Had he really slept with her? A moment ago he'd have sworn he had, but now he wasn't sure. There'd been that flash of recognition, a momentary glimpse of the two of them entwined in an unfamiliar bed, but nothing after that, and now even the flash was gone. He couldn't remember anything about the actual act, where it had been, or when. It couldn't have been recently; he'd been away all through the holidays, and she'd been teaching halfway across the country during the fall semester. Maybe it had just been wishful thinking.

Then again, maybe not. That look on her face was unmistakable. She was waiting for him to say something, to acknowledge their special secret, and Rick had about two seconds to come up with the right response or he was dead meat.

When in doubt, go for the truth. Rick smiled at her and said, "I just had the strongest sensation of déjà vu," putting as much spin into the words as he could without alerting Vince to the subtext.

Marsha blinked her green eyes at him and said, "Now that's odd, so did I."

Not to be outdone, Vince said, "You're kidding. I did too."

Rick and Marsha exchanged a knowing glance, then Marsha turned to Vince. "Oh really? What about?"

Three more grad students entered the lounge, two guys flanking a woman, all three of them wearing the same style suit. Gray, wide lapels, red ties. They stomped the snow from their shoes—black running shoes, it looked like—and made straight for the punch bowl. When they drew close, Rick could see that the woman's oversized glasses had tiny winking lights around the rims, but facing inward, where she could see them better than anyone else could. Rick smiled at the odd trio and sipped his wine while Vince said, "It was really strange, but for just a second there I was sure we were holding an

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awards ceremony for Rick."

Rick tried not to snort Chablis through his nose. The idea of Vince awarding him anything was laughable. Vince had barely spoken to him since their run-in with the NSA over Rick's code-breaking algorithm. Marsha didn't seem to realize that, though, because she asked seriously, "Oh really, what for?"

Vince laughed. "Oh, nothing much. Just solving Fermat's last theorem."

"That's been done," Rick said. "Andrew Wiles, at Princeton."

Waving a green napkin in dismissal, Vince said, "No no, Wiles's proof was a big, ugly, two-hundred page thing. I mean *Fermat's* proof, the elegant one he didn't bother to write down."

Marsha's eyes glittered with mischief. "Well, Rick," she said, "Looks like we know what you'll be doing for the next couple of years, eh?"

"What?" Rick frowned. Both Marsha and Vince were watching him like vultures. Like mathematicians who'd just laid down a challenge. "Oh no," he said. "If you think I'm going to waste my time on that, you're nuttier than Fermat."

But as he said that, he felt a flash of insight, a tantalizing glimpse of the proof, as if he'd already solved it. The moment he focused his attention on it, though, it was gone, just like his night in the sack with Marsha.

On the way home, while he was giving a ride to Nigel, one of the other single men in the department, Nigel said, "I didn't realize you were so popular. I had three different people ask me about you tonight."

"Oh really?" Rick concentrated on keeping the Volkswagen from sliding on the icy streets. It had snowed on New Year's Eve, and traffic had packed it all down before the plows could clear it away. Now they would be stuck with it for months.

"Yeah, they kept asking about your work, and what you were planning next."

Rick groaned. "It wasn't those bastards from the NSA again, was it? I gave up cryptography over a year ago."

"No, I don't think so," Nigel said. "These guys weren't near as slick."

The National Security Agency people had definitely been slick. When Rick had inadvertently stepped on federal toes with his code-breaking project, they had materialized like dark wraiths. A few soft words to the dean of the college, a midnight visit to his office to clean off his hard drive—they'd even found his backup disks in the closet at home, though Rick had found no evidence of forced entry to the house. They had swept through his life in a single night, and Rick had suddenly found himself without a project. A whole year down the tubes, and strict orders from Vince to lay off cryptography.

Now he realized what tonight's little exchange had been all about. Rick hadn't picked a new project yet. He wasn't doing anything exciting, and he hadn't written any papers for over a year. Vince's little bit about Fermat's last theorem hadn't been one-upmanship in the presence of a beautiful new colleague; it had been a hint. Do something or wind up teaching reme-

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dial algebra for the rest of your life.

An oncoming car seemed to materialize out of nowhere, sliding into their lane. Rick dodged to the right, narrowly missing a parked delivery van. "Jeez, where did that guy come from?" he said as the headlights swept past, but as he spoke, his mind was already leaping off on a tangent.

"Graphically," he whispered. "I can solve it graphically."

"What?" Nigel asked.

"Nothing," Rick said.

He lay awake that night, the yellow sodium vapor glow from the streetlight casting shadows of tree branches on the wall. They curved and zagged in the illuminated square, and Rick tried to envision them as lines on a graph. How could they illustrate Fermat's last theorem?

Fermat's was one of the oldest—and simplest—unproved theorems in mathematics. Pythagoras had proved that the sides of a right triangle added up by the relationship $A^2 + B^2 = C^2$, and it was easy to show that there were an infinite number of integer solutions to the equation, but no one had been able to find an integer situation in which $A^3 + B^3 = C^3$, or for any higher powers either. Nearly everyone believed that no such solutions existed, but nobody had been able to prove it.

Nobody except Pierre de Fermat. He had been more of a hobbyist than a mathematician, but he was good at it. He had made some big advances in probability theory, and had nearly invented calculus. And in the margin of Diophantus's *Arithmetica,* beside the section discussing integer solutions to $A^2 + B^2 = C^2$, he had written his theorem, adding, "I have discovered a truly remarkable proof which this margin is too small to contain."

Mathematicians had been trying for over three centuries to figure out what the Frenchman had had in mind, but so far without success. Andrew Wiles had come up with a proof in 1993, but it wasn't elegant and it used semistable elliptic curves and hyperbolic planes—math that Fermat couldn't have known about. Fermat's proof had to be simpler, maybe even visual.

Rick tried to recall the insight he'd had in the car, but it was gone. Vanished as completely as Fermat's own proof, which Fermat had never bothered to write down even though he'd had another twenty-eight years of life to do it after scribbling his tantalizing note in the margin.

Marsha came by his office the next day to borrow his stapler. "I've got to tack up a few spreadsheets to make it feel like home," she said.

"I know what you mean," Rick said, uncovering the stapler from the piles of notes and student papers on his desk. He wondered again where he could have met her before. It bothered him that he'd misplaced the memory of an entire romance, if that's what it had been. Maybe it had been a single drunken revel at a convention somewhere.

Marsha took the stapler from him, but instead of leaving she sat down in the chair beside his desk and said, "So are you actually working on Fer-

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mat's last theorem?"

Rick laughed. "I wasn't until Vince brought it up, but since then I've had a couple thoughts I might pursue. I doubt if it'll come to anything, though."

She shrugged. "You never know." There was a moment of uncomfortable silence, then, "You never told me what your déjà vu experience was last night."

He felt himself blushing. "I, uh, well, I suddenly remembered that we'd met before."

"Oh," she said. "Have we?"

That settled that. She didn't remember it either, so they must not have. Not that he'd have minded; she was a striking woman, and a genuine memory of a night with her would have been a great discovery to dredge out of the dark corners of his mind. He sighed. "I thought so, but then a moment later I wasn't sure."

"That's the way with déjà vu."

Rick thought back to the party. "Didn't you say you'd felt something, too?"

"Yes, I did. For a second there, I thought I'd been an instructor here before."

"Wow, Vince had a flash, too. What do you suppose the probability is of that happening to three people simultaneously?"

Marsha laughed. "Well, how often do you get déjà vu? Once a week, maybe?"

"Who knows?" Rick leaned back in his chair. "I suppose that's a fair ballpark figure, though."

"And the experience lasts for what, a minute at the most?"

"Sure." He could see where she was going now, so he said, "One minute out of let's see . . . fourteen-forty in a day, so just about exactly ten thousand minutes in a week. Jeez, for three simultaneous events, that's one in ten thousand *cubed.*"

"One in ten to the twelfth," Marsha said. "One in a trillion. Holy cow."

Rick whistled softly. "Mysterious forces are about."

"Yeah, sure." Marsha shook her head. "Now figure the odds of *some* mysterious coincidence out of the thousands of things that happen every day, and suddenly it doesn't seem so surprising. It'd have to happen again before I'd believe there's anything going on."

Rick held up his left arm. "We'll have to synchronize our watches, so we can compare our experiences. Or—" he paused, considering his next words carefully. "Or spend more time together."

She tilted her head. "Oh? What did you have in mind?"

"Well," Rick said, wiggling his watch. "It's about lunch time. Have you tried the faculty dining hall yet?"

"No, I haven't."

Rick stood up and pulled his coat off the stand by the door. "By all means, then, let me show you where it is."

The sidewalks were even icier than the streets, and since Marsha was wearing smooth-soled shoes Rick offered her his arm. That was his excuse, anyway.

"So tell me about your ideas for Fermat's last theorem," she asked him

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as they crossed the open quad from the math offices to the dining hall.

He told her about the sudden flash of inspiration he'd had on the drive home the previous night, how he'd thought of solving it by showing the relationships among A, B, and C visually, but how he'd lost the thread before he could write it down.

"Maybe that's why Fermat never wrote it down either," Marsha said, laughing. "Maybe he forgot it after he wrote his note in the margin."

"God, that'd be terrible," Rick said. "I just had a glimmer of hope, but imagine having the whole proof in your head and forgetting—" He stumbled, and Marsha had to help him stay on his feet, but he didn't start walking again.

"What is it?" she asked.

"Quick, do you have something to write on?"

She patted her coat pockets. "No. Why?"

"Arrgh! Neither do I, but I've got it. I know how to solve it!"

"You do?"

"I—think so." He turned half around, contemplating a sprint across the ice to his office, but he knew he'd never make it. Not before the memory faded. It was fading already. "Here," he said, gripping Marsha's arm fiercely. "Listen. In order to get an integer solution, you've got to have three integers whose squares or cubes or whatever are close enough together that two of them *can* be added together to make the third, right?"

"OK," Marsha said, nodding.

"All right, we know it works for squares, so let's look at cubes. Three cubed is twenty-seven, and four cubed is sixty-four, so their sum is ninety-one, which *is* less than five cubed. So we know that three and four don't work. So now look at the general case, where you try it with *any* three consecutive integers. If you can show that no solutions exist for any of them, then you've proved the theorem."

"What about three cubed plus, oh, seven cubed?" Marsha asked. "Or ninety-seven cubed. Wouldn't you have to test every possible combination of integers?"

"No, no," Rick said excitedly. "You just look at consecutive ones, because they're the limiting case. You don't test for three and ninety-seven, because you test for ninety-*six* and ninety-seven, and if the sum of *their* cubes is less than ninety-eight cubed, then you know the sum for three and ninety-seven is going to be less."

"Sure," Marsha said. "But how do you show that for all cases? There's still an infinite number of consecutive integers."

"Graphically," Rick said immediately. "Yes, of course! Graph all the cubes of all the possible A's and B's and C's, and—and—damn."

"What?"

"I've lost the thread."

"No, no, think. Graph all the possible sums of consecutive cubes, and..." she trailed off hopefully. "And...?"

Rick shook his head. "And I've lost it. It blinked out like a popped soap bubble."

She tugged him into walking again.

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"Come on, let's get back to your office and think this through. You had something; we'll track it down."

Rick let her lead him back while he tried desperately to remember his thought. He squeezed his eyes shut, opened them again, and saw three students standing beneath one of the bare trees to the side of the path. Were they—? Yes, they were the same grad students who'd arrived late at the party last night. Great; he'd drawn a crowd. Before the day was out, Vince would no doubt hear about his newest professor and Rick brainstorming arm-in-arm in the middle of the quad.

They tried all afternoon to reconstruct his train of thought, using his computer to graph every combination of squares, cubes, fourths and so on they could think of, but whatever spatial relationship he had visualized in that moment in the quad refused to materialize on the screen.

What *did* happen, though, was that Marsha edged her chair a little closer and a little closer to his over the course of the afternoon, until she might as well have been sitting in his lap. As Rick's frustration with Fermat's last theorem grew, he began to pay more attention to the woman by his side. A sudden rumble made them both look down at their stomachs, then Rick broke out laughing. "Guilty," he said. "And I'm guilty of making you skip lunch, too. Would you let me take you to dinner?"

She rubbed her eyes and leaned back in her chair. "Sure. But this time bring a notebook and a pen."

* * *

Over steak and shrimp in a quiet corner of the Bayview Inn, Marsha said, "You know, I forgot all about it in the excitement, but when you had your flash of inspiration there in the quad, I had another shot of déjà vu myself."

"Impossible."

"No it's not. The odds for two of us are just a hundred million to one."

"Hah. What did you remember?"

She got an impish grin and rolled her eyes toward the ceiling, but she finally said, "Well, I saw a whole chain of events leading up to my asking you up to my apartment for the night."

"You're kidding."

Marsha toyed with a shrimp on her plate. "I usually don't kid about that sort of thing."

"No, I didn't mean it that way. I meant, That's wild, because that's the flash I got *last* night."

"What?"

"Last night, at the party, when I said I'd just had a moment of déjà vu, that's what I'd seen. You and me going to bed in an upstairs apartment. Yellow curtains on the windows, and flannel sheets with little sheep printed on them."

"That's my bedroom!" Marsha said. "Do you remember anything more about it?"

He shook his head. "Not about the room, but, um, you've got a couple of freckles just to the side of your left breast."

She dropped her fork to the plate. "This isn't really déjà vu we're having, is it?"

"I don't think so. It's more like pre-

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cognition or something."

"Does that mean you're going to solve Fermat's last theorem?"

Rick shrugged. "Who cares? What I want to know is whether or not you're going to invite me up to your apartment tonight."

Her impish grin returned. "I don't know. You haven't kissed me yet. I never invite a man up to my apartment unless he's a good kisser."

"Well," Rick said, leaning forward and puckering his lips, "I'm willing to take the test."

Rick woke in the middle of the night with the answer fully-formed in his mind. He reached for the note pad he always kept on the nightstand, but his hand met something cold and hard that didn't belong there, tipping it over with a crash. Oh, right. Different bedroom.

"What was that?" Marsha asked sleepily.

"Sorry," Rick muttered. "I think I tipped over the lamp."

"S'all right," she said, snuggling up against him. "Worry about it in the morning."

"But I—" need a note pad, he almost said, then he realized he didn't after all. Whatever his thought had been, he'd lost it again.

He lay back down and stared at the ceiling. What the hell was going on? Marsha was right, this wasn't just déjà vu. Something was happening to their minds.

Everything in the room had a silvery tint; the Moon had risen while they slept, and was now shining on the bed. A shadow drifted slowly across the foot of it, and Rick thought for a moment that it must be from a passing car's headlights, but then he realized the angle was all wrong for that. It had to be something up in the sky.

He looked out the window and realized there was a third possibility: Someone was walking along the flat-topped roof of the next building over, and the Moon behind him threw his shadow directly into Marsha's bedroom. It looked like the guy was carrying something on his shoulder, something that glinted in the moonlight.

A gun? No, it was too big for that, unless it was a bazooka. It looked more like a telescope. Oh, sure. The night was clear and the Moon was bright as could be; it was probably just an astronomy student out there.

Or a Peeping Tom. As Rick watched, the person on the roof set the telescope on a tripod and pointed it straight at Marsha's window. When he bent down to look through it, Rick raised his head into the shaft of moonlight, middle finger extended.

The person with the telescope leaped back as if Rick had punched him in the nose. Rick slid out of bed and stepped to the window, just to let the guy know for sure he'd been spotted. He was about to open it and shout at the son of a bitch when the man took another step back, tripped over something, and disappeared.

"Oh shit," Rick said.

Marsha sat up. "Now what?" she asked.

Rick swept his hand around in the darkness at the foot of the bed, look-

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ing for his clothes. "I think somebody just fell off the roof over there."

"What?"

"Somebody was looking at us with a telescope. When I flipped him off, he backed up and dropped out of sight."

"There was somebody looking at *us?*" Marsha asked.

"Don't worry, he just got there." Rick tugged on his pants and shirt, found his shoes and put them on without socks, and said, "Keep an eye on the roof. I'm going over there and look for a body on the ground."

"Shouldn't we call the police?" Marsha asked.

"Not until we know there's a reason to," Rick said. "It'd be better for both of us if we didn't have our names in the paper."

Marsha nodded. "Good point."

Rick grabbed his coat on the way out. It was cold as hell stepping into the winter night straight from a warm bed, but he tugged the zipper up to his neck and stuck his hands in his pockets while he jogged across the courtyard, the snow squeaking beneath his shoes.

There was nobody on the ground on either side of the building. No tracks, either. The guy hadn't gone over the edge, then, and he had to be still in the building. Rick tried the front door, but it was locked, so he went around to the side with the fire escape and leaped up, caught the counterbalanced ladder with one hand and pulled it down. Then, hoping nobody else had called the police either, he crept up the iron staircase three flights to the roof.

The telescope was still there, but Rick couldn't see the guy who'd set it up. He approached the scope cautiously, looking for tracks in the snow, and sure enough, he found some. A semicircle had been trampled down behind the telescope, and four distinct prints led backward away from it where the peeper had retreated. but they didn't go anywhere. They vanished into smooth snow, as if the guy had leaped into the sky.

Rick looked for the other end of the trail of footprints, the ones whoever it was had made when he approached, and he saw the same thing. Footprints suddenly appeared in the snow, leading a dozen feet or so up to the telescope.

Too strange. Rick turned once around, looking for anything he might have missed, but he was alone on the rooftop. Alone and cold. With a shrug, he waved at Marsha's silvery form behind her window, then picked up the telescope and carried it back down the stairway. Let the Peeping Tom come after it if he wanted it back.

"It doesn't have any lenses," Marsha pointed out when they'd set it up in her living room. "Mirrors either." Rick looked down the front of the tube and realized she was right, but when he aimed the telescope at the Moon and looked through the eyepiece, he saw a heavily-cratered surface that looked close enough to touch.

"Something's certainly doing the job," he said. He aimed it down to-

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ward the one lit window in the building across from them and looked again. He could see into the room—a kitchen, it turned out—as clearly as if he had his face up against the glass, and now he heard a woman's voice saying, "Come on, honey, get up or you'll be late for work."

"What did you say?" Marsha asked.

"I didn't say anything," Rick said, stepping aside so Marsha could have a look. "It sounded like it came from the telescope."

"No way." She peered into the eyepiece. Rick saw movement in the window, and Marsha said, "A woman in a blue bathrobe just walked past."

The voice said, "I'll cook you a couple of eggs. How do you want 'em?"

"Scrambled," a male voice said.

"This is bizarre," Marsha whispered, backing away from the telescope.

"It's the NSA again," Rick said disgustedly. "They're the only people who could possibly have access to something like this."

Marsha looked at him with wide eyes. Every mathematician lived in dread of the NSA. "What do we do?"

"Damned if I know," Rick said. He examined the telescope again. "Nikon?" he muttered, reading the label on the side of the tube.

"Yeah, right."

"No, really, that's what it says."

Marsha bent over to look, and that motion triggered another flash of déjà vu: Rick clearly remembered seeing her bend down to look at his proof of Fermat's last theorem, the one where he graphed $A^n + (A+1)^n$ and $(A+2)^n$, and the graphs proved that the two functions never intersected. But exactly what was being plotted against what?

Marsha gasped. "They're going to break in," she said.

"Who?"

"Them." She pointed toward the roof across the way, where three figures had appeared. They were black silhouettes against the Moon, and each one turned around a couple of times, evidently looking for their 'scope. Rick pointed it toward them and heard a man's voice say, "The doot must have come up and grabbed it."

One of them turned and looked toward Marsha's apartment. Rick reached out and switched off the light, but it was too late. The voice said, "Yada, there they are."

"Now what?" another voice said.

"Rewind?" the third one, female, said.

"Nodo. I've already crossed myself twice," the first voice said. "I do it again and I'll spring a twonky a month long."

"Bort that," the woman said, "Let's just go take it back."

"But won't that snark his discovery? We trang that up and the department'll send us all back to the Cretaceous."

"We've *already* tranged it. If he's figured out how to work the scope, he's probably—"

"Like it's really tough to point it at something."

"—Listening to us right now."

"Oh skrot, you're right. Let's bounce before we snark it up any worse." One by one all three figures

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disappeared again, and this time there was no doubt about them falling off the roof or hiding behind something. They simply vanished.

"That's not the NSA," Marsha whispered.

"No, I don't think so," Rick whispered back. "But whoever they are, you were right; they're coming here."

"What can we do?"

"Have you got a gun?"

Marsha shook here head. "Just pepper gas," she said, taking her purse from the table by the door and removing the leather-covered spray canister from inside it.

"Good," Rick said. "Get ready to use it." He went into the kitchen and grabbed the broom from the corner by the back door, busted off the bristled end by stomping on it, and swished the ragged broken end back and forth in the air. "This ought to do," he said. "Now we stand back to back in the living room and wait for them to make their move."

They took up their positions. "Don't hesitate," Rick said. "Spray 'em all the moment you see a target."

"Right." Marsha held out the pepper canister. "Shouldn't we call the pol—"

But it was too late. With a flicker of light and a whuff of displaced air, the three figures from the roof materialized right beside them. Rick felt a moment of intense déjà vu; he could hardly see their black-clad shapes through the sudden visions of the elegant graph proving Fermat's last theorem, but he swung around with the broomstick and flailed away at the shadowy figures beyond it.

Marsha spun and sprayed with the deadly accuracy of a city-bred woman, and all three intruders dropped to the floor, coughing and choking. A beam of blue light shot out from one of them and struck the wall beside Rick, and he leaped aside and whacked at the source of it with the stick. He felt wood strike flesh, and the light winked out. Holding his breath and blinking to regain his sight, he reached down and picked up a wide-barreled pistol-gripped flashlight and backed away again.

"Got any rope?" he asked.

It took fifteen minutes before any of their captives recovered well enough to speak. Rick and Marsha had tied them to kitchen chairs, and stood back to wait. In the bright overhead light, their stealth-black oversuits looked less threatening, almost silly.

"I recognize all three of them," Rick told her. "They were at your welcoming party, and in the quad when we both got hit by that déjà vu. And I'd be willing to bet they were in the car that came at me from nowhere on the way home, too. Weren't you?" He pointed the blue light gun at the most-recovered of the intruders.

"Hey, watch that," the kid said, still sniffling from the pepper spray. "You pop me with that, you'll twonk the whole connie."

"You want to put that in English?" Rick asked.

"What part didn't you snag?"

"Twonk."

"Twonk? You're tranged. I'm sure that's a twencie. From way before your time, in fact. Means screwing up

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the time flow. Leaving a twonky, like a magnoscope on a rooftop."

Marsha said, "I think he means an anachronism."

"Straight! You twonk the connie—that's *continuum*—and you cause all sorts of problems downstream."

Rick leaned back against the kitchen counter. "Are you trying to tell us you're time travelers?"

"Ain't trying to tell you nada. You asked."

Rick wouldn't have believed a word of it if it hadn't been for the telescope in the living room, and the way his head filled with future memories every time these guys showed up. Did time machines leave some kind of wake that caused déjà vu?

"What are you doing here?" he asked.

"What do you think? We're here to dock you solving Fermat's last theorem."

"Dock?" Marsha asked.

"Doc-u-ment-a-rize," the kid said. "It's a field lab in historical vidding."

Rick laughed. "You're nuts. You're *tranged*. I haven't solved it. I wasn't even interested in it until you guys showed up at the party last night and gave Vince the idea."

"We didn't give nobody zot."

"Ah, but you did." Rick tugged a paper towel off the roll beneath a cabinet and drew a quick XY axis on it with a pen from the cup by the phone, then he swept two curves upward from the origin. "That's it, right?"

The kid's eyes bugged. "Torrie, you get that?"

The girl coughed. "You skrottin' me? I can hardly see." Rick wondered how she could see anyway; her glasses—as lensless as the telescope—blinked from the frames with a dozen different colors, all aimed inward.

The kid said, "Skrot, that would've been maxie. The whole concept swished out in four lines on a napkin. Maybe we can get him to do it again. Will you?"

"Weren't you listening?" Rick said. "I got the idea from *you*. Every time you show up, I see it in my head."

There was a long silence, then the woman, Torrie, said, "Uh oh."

"It's leakage," Vrank said. He was the talkative one, the narrator for the "dock." He explained what Torrie and Shil, his camera and sound ops, were doing as they spread the guts of their time machines out on the kitchen table. Rick and Marsha had finally decided to let them go once they'd promised not to snark anything up.

The time machines looked like fanny packs until Shil unzipped their flaps and unfolded them into flat, floppy panels of circuitry. Vrank said, "There's supposed to be suppressors in there to keep down the ripple effect when we chrono, but evidently one of 'em's tranged. Sorry about that."

"Sorry?" Marsha said. "You've put Rick through the wringer."

"It's worse than that," Vrank said. "We've evidently twonked his whole life. You honestly weren't even thinking about Fermat's last theorem until

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last night?"

"Nope," Rick said.

"What about the journal?" Torrie asked. "You wrote in your journal that you got a flash of inspiration at the reception, and again on the drive home, and you described how you worked on it for days after you met Marsha here, 'cause you wanted to impress her."

"What journal?" Rick asked.

"Twonky," Shil said, poking at a couple of bumps and a squiggle in the dark fabric. "The journal's a—yada, sure enough, here's the prob. It was yours, Vrank."

"Skrot. Now what?"

"Can't you go back and undo it?" Rick said, leaning over the table to look at the offending circuit. It looked like someone had doodled with a laundry marker on a piece of gray nylon. "Can't you tell yourself to fix your time machine before you leave?"

Vrank shook his head. "For one thing, looping like that's a good way to trang your brain, but even if I tried it, that'd just dox it up even worse. We came back here to dock your discovery, which means you *do* figure it out."

"Or at least he gets the credit for it," Torrie said.

Shil looked up from the time machine. He and Vrank and Torrie exchanged knowing glances. "It'd work," Shil said.

"It would, wouldn't it?" said Vrank.

"What?" Rick asked, backing warily away and getting ready with his broom handle. "What would work?"

"Going with it. Docking your discovery the way we originally intended to."

"It's not my discovery," Rick said. "You guys planted it."

"Yada? Then where did it come from?" Vrank asked. "*We* got it from you."

There was a long, pregnant silence, then Rick pulled out a chair and sat down. "My head hurts," he said.

"It's not a proof," he said the next morning. Torrie and Vrank and Shil and Marsha were gathered around Marsha's computer, where Rick had displayed a graph of his brainstorm, but on the screen where the two curves were supposed to diverge and thus prove that no integer solutions existed, they crossed.

"That's not right," Vrank said. "You're missing something."

"Obviously."

"Cheer up," Torrie said. "You'll get it soon. Your journal said it took you just a few days."

"No pressure," Marsha said, giggling.

"Yeah." Rick stared at the screen for a few minutes, then said, "So Vrank, why don't you jump forward and back again, give me another hint."

Vrank laughed. "Sorry. Shil fixed the chrono, so it wouldn't do any good."

"Besides," Torrie said, "we need to get some good shots of you thinking. It wouldn't do to have you spring it right off, or people downtime would know for sure what happened."

"Couldn't have that," Rick said sourly. He tapped at the keyboard,

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changing the display from fourth to fifth power integers, but the parabolas still crossed.

"Actually," Marsha said, "isn't their intersection a counterexample? Maybe you can prove the theorem *wrong*. That would be just as big a deal."

Rick thought about that, then said, "The intersection points aren't necessarily rational numbers. Besides, Wiles proved the theorem true already. I'm just looking for a more elegant one. And trying to impress you, of course." He put his arm around Marsha. She was the one good thing to come of all this.

A week later, he was getting used to having people from the future popping in and out of his office, his living room, even his bedroom. He drew the line at his bathroom, demanding at least one safe refuge, but that didn't help him either. The theorem and his flawed proof of it haunted him no matter where he went, and *that* was what was driving him nearly crazy.

He called a halt to it the next time Vrank and his crew showed up in his office. "Look," he told them, "it's not going to work. The whole concept is bogus."

"No, no," Vrank assured him. "You're close. I can tell."

"Yeah, why don't you?"

"What?"

"Why don't you tell? Just give me the solution, I'll write it down, you can finish your documentary, and I can get back to my life."

Torrie frowned. "That wouldn't make for good drama."

"You want me to climb in a bathtub and shout 'Eureka'? Fine. Write me a script. But I'm tired of trying to validate your mistake. I never wanted to work on this stupid theorem anyway."

Shil looked up at the clock and grinned. Rick said, "What's so funny?"

"Twenty minutes from now you won't be saying that."

"Oh?" Rick looked from Shil to Vrank to Torrie. All three had big grins on their faces. "What, this is the big moment?"

"Yada," Torrie said. The telltales around her glasses winked red and yellow.

Rick looked back to the mess of papers on his desk. He'd given up on the graphical route, and was trying to come up with a completely new paradigm. "No way," he said. "I'm completely at sea here. I couldn't prove the Pythagorean theorem in twenty minutes."

"Come on," Torrie said, "try."

Rick turned back to his desk, conscious of her glasses recording his every move, and tried to concentrate on the problem. What was he missing? He shuffled through the pages of graphs and the tables of logarithms, tapping his pencil on the tiny corner of bare desktop. Out of perversity, he picked his nose. If he concentrated, he could hear the clock humming, the second hand sweeping around and around.

When twenty minutes had come and gone, he looked up again and said, "I think it's time for plan B."

The proof from the future was no

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better than his own. Rick had called Marsha into his office to see it, but the two of them read the article in the futuristic plastic unibook with growing confusion. "It's not a proof," Rick said, using the recessed toggle on the side to flip back to the abstract on the first page. "It says it is, but it's got the same problem I have with mine. Doesn't anybody do peer review in the future?"

"That's your article," Vrank said, his voice worried. "I downloaded it straight out of the archive."

"It may have my name on it," Rick said, "but I'd never try to publish something with this basic a mistake in it."

"Then it's twonked," Shil said. "Our little snark-up here must have rippled down the connie and changed it."

"Oh, skrot," Vrank said, grabbing the door frame for support. "Rick, you've got to solve it. If you don't, we're doxed bad."

"Sorry," Rick said. "I've given it my best shot."

There was a moment of silence while everybody scratched their heads, then Marsha said, "Why don't we go to the source?"

"We're *at* the source," Vrank said.

"No, I meant Fermat. Why don't you go back to 1650 or whenever it was to get the proof from *him?*"

Vrank and his companions shuffled back and forth nervously, and finally Vrank said, "Well, uh, actually, we already did. He didn't have a proof either."

"You're kidding." Rick laughed. "He didn't have a proof?"

Vrank shook his head. "We docked his life before we got to yours, just for a prologue, you know, but it turned out he was wrong when he wrote that note in the margin. He had a flash of inspiration, but it turned out to be—"

Rick's laughter drowned him out. "Your time machine!" Rick said when he got his breath back. "The one with the bad filter. You did the same thing to him that you did to me."

Vrank blushed. "Yeah, I guess so."

"Then there never *was* a proof. Never was, and never will be. Except for Wiles's semistable elliptic curves."

"Yada." Vrank sighed and turned to his companions. "We're snarked, dooties."

"What happens now?" Marsha asked.

"Nothing, at least from your point of view. We, on the other hand, get to bounce back downstream and see if anybody's filed a complaint."

"And if they did?"

"Then we have to pay a fine and make resti to anybody whose life got screwed up. Not to mention re-taking historical vid."

"You don't just go back and undo the mistake?"

Shil laughed. "Define 'mistake.' We came back to dock Rick solving the theorem, which he wouldn't even have tried if we hadn't. But we wouldn't have come back here in the first place if he hadn't done it already, so maybe we should trang the ripple suppressors in Vrank's chrono again and bounce back and forth across the herenow until he twigs to it, hey? Which is the 'real' connie?"

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"This is," Rick said after a moment's translation. "You've screwed with my head enough already; just leave well enough alone and go pay your fine."

Vrank nodded. "That's the way the judges usually figure it, too. Well, wish us luck." He tapped his forehead in a mock salute, reached down to touch a control on his fanny pack/time machine, and vanished. Torrie and Shil blinked out a moment later.

"Whew," Marsha said, leaning back in the chair beside Rick's. "I was afraid they were going to undo everything all the way back to me getting hired here, and I'd never have met you."

Rick gave her a hug. "I'd have given them the proof before it came to that. I was just holding out to see if I could get them off our case entirely."

"What?" Marsha stared at him with wide eyes. "You *did* figure it out?"

"That's right." Rick shuffled through the papers on his desk. "Hmm, that's strange," he said. "I had it here a minute ago." ■

AUTHOR'S NOTE: In order to properly research this story, I, of course, had to find an elegant solution to Fermat's last theorem. It is indeed a truly remarkable proof, which the margin of this publication is also too small to contain. Fortunately, the editor has graciously agreed to print it in a separate appendix, which can be found on page 179.

Biolog continued from page 69
come his own publicist, since publishers often fail to do enough. At his own expense, he sent bound galleys of his first book to reviewers. This resulted in a sale to the SF Book Club and a three-book contract from a Japanese publisher. He does his own press releases, with overwhelming response in newspapers, magazines, and TV interviews. He has done over 30 readings in Canada and the United States at conferences, bookstores, and libraries.

Rob insists that his writing be as scientifically accurate as possible, and pivot around some real problem. He notes that too much of today's SF is commercial fiction written to fill slots in publishers' schedules, and often poorly done and juvenile. Endless, open-ended series of mindless adventure fill him with disgust. He tries to make each of his own stories an individual, polished gem, often written around a core mystery. Settings are Canadian.

Rob notes that SF no longer is exclusively an American phenomenon, but is published worldwide. His best word of advice to an aspiring writer is to aim for excellence rather than turning out shoddy work because he can get away with it sometimes. In the long run, you'll do better. ■

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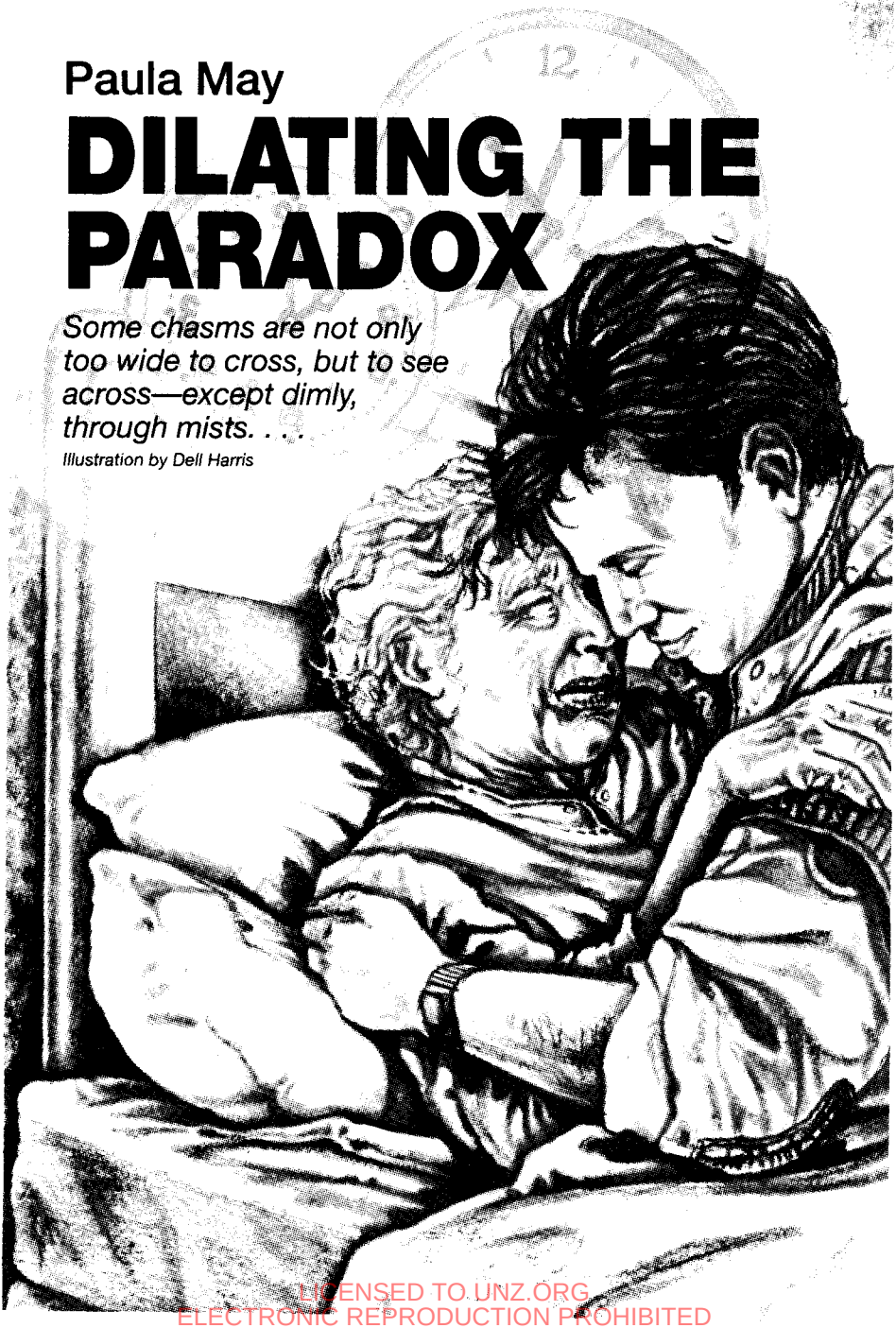
Paula May

DILATING THE PARADOX

Some chasms are not only too wide to cross, but to see across—except dimly, through mists. . . .

Illustration by Dell Harris



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Rose woke up gradually, wandering into consciousness as she so frequently wandered out of it these days. The wall clock across the room read 10:15, but there was no way to tell if it was morning or evening. They kept her blinds drawn up tight unless she specifically asked for them to be opened. Did they think she wanted to shut herself away from the world?

She glanced toward her visitor's chair in case it was morning and someone had come in while she slept. There in the chair sat the Captain. She could see him clear as day, looking almost as she remembered, a bit older, perhaps. Impossible, of course, but not surprising. A while back, Rose'd had visitors and she'd been sure one of them was cousin Greta, who'd died at least eighty years ago. The directionality of time was coming unstuck for Rose. One of the side effects of the close approach of death. Another of the good Lord's little jokes.

She let her gaze slip away from the mirage, across her present reality, snagging momentarily on the garish artificial flowers on the bedside table, resting more comfortably on the bright splashes of the great-great-grandchildren's watercolors pinned to her cork board. The family tried to liven the place as best they could, but the Center's rules forbade such comforts as live plants, sound systems without headsets, hanging anything on the bland beige walls, so it still felt just like what it was, a long-stay hospital room. Rose was glad that she could at least afford a private room. So many couldn't.

She looked at the chair again. It still seemed to be occupied. She could see sweat standing on the man's brow, the warm room her thin blood required too much for him. Did mirages sweat? Perhaps there really was someone there, some young relative she hadn't seen for a while, whose features reminded her easily-confused memory of the Captain. She remembered Captain Robert Coyle more clearly than might be expected, given that she had last set eyes on him more than a century ago, because she was always seeing little bits of him in her children and in her children's children. This one's appearance, that one's walk, somebody's voice, another's abilities. The wonder was that she hadn't thought she was seeing the man himself before now.

Well, if there was someone there, she should be polite and say something. "Hello, there, in the chair."

He shifted, straightening slightly, smiled. "Hello, there, in the bed."

A smart-alecky young relative. Good. Might even wake her up a little.

"Would you mind opening my blinds for me? I can't tell if it's day or night."

He got up, limped across to the window and pulled the blind right up to the top. "It's morning, Rosie. A bright, hot, sunny morning."

Lord, he even sounded a little like the Captain. Probably would have moved like the Captain, too, if he wasn't lame. Must be a recent injury. They'd fix it soon. He was well under 125 years old, still be covered by standard health care. Not left to his

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own resources, like she was. For the life of her, she couldn't place him. Not only did she not remember his name, she wasn't even sure which branch of the family he came from. Somebody's guilty secret, maybe? No, though he seemed quite well-mannered, he hadn't introduced himself. That meant he thought she ought to know who he was. Perhaps it would come to her if she gave herself more time.

Sunny. He'd said it was sunny.

"I never see the Sun from here, but my little patch of sky does look blue. I imagine it *is* a beautiful day."

He came back to stand beside the bed. "Would you like to go outside? I can take you out in a chair."

"No, thank you. Just getting from bed into a chair tires me right out. Can't even go down the hall to have my hair done anymore."

He sat again. "Maybe we should try to get you stronger."

Rose shook her head. "Can't be done. It's my heart. After 146 years, it's just had it."

"Get a new heart."

"I can't afford a new heart. Anyway, a new heart would probably blow my old arteries wide open. No, I'm fine just as I am. Except for these ugly beige walls. I've always hated beige. One of the Lord's last little jokes on me, sticking me twenty-four hours a day in a room with nothing but beige walls."

"Move to a prettier room."

"All the rooms here are beige. And I can't afford any classier geriatric center than this one."

"I can. Anything you want. Just tell me." He leaned forward, reaching toward her across the bed. "Just tell me what you want."

Rose frowned, peering closely at his face. He seemed eager, his eyes pinched with tension. Hanging over her like that, he made her feel uneasy.

"I pay my own way. Don't want anybody giving me charity, even relatives."

Now he frowned. "Relatives? Don't you know who I am, my American Beauty?"

Rose's heart lurched with anger. "How dare you call me that? I like a little wit in young people, but you've got no right to try to make a fool out of an old lady. You do favor the Captain, true enough, but I'm not so far gone I'm going to think you really *are* him, even if I was brought up knowing he'd survived the explosion that threw his ship toward the stars." She was furious. "So he promised in that last message to come home if he could. So what? The odds against him were too long to take the promise seriously. As Mother did."

Rose pulled herself up short.

She wasn't really angry with the young relative. He'd somehow tapped into an old pain, loosed the anger she'd never been cruel enough to vent on her mother, never been able to vent on the faint-hearts who were truly responsible. All that power, the first true star drive, in the hands of bureaucrats who couldn't think of anything better to do with it than tootle back and forth to Mars. All that power on too short a leash, an accident waiting to happen.

The man sat back, raising his hand

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to cover his eyes.

A dark suspicion came to Rose's seething mind. "If you're after my money, you're wasting your time. I signed everything over to the Center when I came in. I can't give you anything."

"I don't want your money, Rosie." He sounded tired. "I have back pay coming." He dropped his hand heavily into his lap.

His eyes were bright with tears. As Rose stared, a single tear spilled over the lower lid of his left eye, sliding down his cheek to hang trembling on his chin. His nose was red, too. He was truly crying. He must really need the money, to play out the charade so. Rose felt bad for him.

"There, now, don't be upset. I don't quite recall your name, but I can tell by looking that we're related, with you favoring the Captain so. I'm sorry I can't help you. There's money in some of the younger branches, though. Maybe one of them can help."

The tear fell as he sniffed. "They told me not to come. They don't understand. All those hard years. Too late for Marina, but I hoped in time for you. I hoped."

Marina. Rose's mother. She'd hoped too hard. At the last, the hope that the Captain might come back had become the fear that he would come hurtling back, still young, to find her grown old with time that had never passed for him. The lover's paradox, far worse than the twin paradox. Poor mother. And poor young man, with no hope at all but old Rose.

"I hoped too, but I didn't hold my breath. I got on with my life. Only thing to do, really. It's the same for you now." A yawn crept out before she could stifle it.

"I've tired you. I'm sorry." He stood, pushing the chair back against the wall. "I know we didn't get off on the right foot, but I'd like to come again tomorrow, if I may."

"If you promise no more silly games, you may come."

"No more games."

Rose yawned again. "My apologies, but I'm afraid I still can't quite place you. You'll have to tell me your name."

"My name is Robert."

Of course. "Named after the Captain, no doubt." She smiled.

Robert smiled back. "No doubt."

"Well, Robert, give the old lady a kiss and let her get some sleep."

Obligingly, Robert leaned over the bed, kissing her gently on the cheek. He brushed away a wisp of white hair that had fallen over her left eyebrow and said softly, "Sleep well, Rosie."

Rose breathed in the slight musky warmth of him. A rush of memory carried her away, her father tucking her into bed that last night before his departure on the milk run to Mars, the last time she ever saw him, hot summer night, his big warm hug. Impulsively she reached up and hugged Robert, remembering. "Goodnight, Daddy," was all she'd said, the sum total of her last conversation with her father. If only she'd known. But it was supposed to be for a few months, not forever. The door had closed so quietly as he left that night.

Tears flooded Rose's eyes. She

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pushed Robert away. He straightened, but stayed beside the bed. Rose tried to flick the tears away with her cold, dry fingertips. Her throat was too tight to speak. He must think her a pitiful excuse for a matriarch. Embarrassment only made the tears worse.

Finally, Rose managed to clear her throat. "Time dilation isn't exclusive to outer space, I guess. Just for a second, it happened right in here." She touched her chest. "In my heart, I was nine years old again, saying goodnight to my father. My own relativity paradox. God's just full of little jokes that make old ladies look foolish. I hope you'll still come back to visit me."

"Of course I will," Robert said, his voice tight.

Rose smiled at him through her tears. "Good. I'll see you tomorrow, then. Goodbye." She closed her eyes and turned her head to one side, to let him know he should leave.

Robert stood there a few seconds longer, then smoothed the sheet over her legs. "Goodbye, Rosie."

She heard his footsteps move across the room, heard the click of the door handle turning. A thought came.

"Robert?" She opened her eyes and looked toward the door.

He stood in the doorway, his hand on the knob. "Yes, Rosie?"

"You have to move on, you see, because that's the only way you can look back. Move on, you remember with love. Keep things the same, you end up angry, bitter or afraid. I moved on. I love my memories of the Captain. I missed him, of course, and Mother was heart-broken, but still, he was the first human to leave the Solar System, planned or no, and growing up the only child of a noble explorer wasn't so bad. So, though it hardly seems suited to someone of my age, if you really want to call me American Beauty, well, I think I'd enjoy that."

"Would you? I will, then. Thank you. Until tomorrow, my American Beauty."

Rose closed her eyes again. "It was my father's nickname for me, you know."

"I know," Robert said. The door closed so quietly as he left. ■

MOVING?

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NASA GOES FTL PART 1: WORMHOLE PHYSICS

This column is about the "Advanced Quantum/Relativity Theory Propulsion Workshop," a gathering held at the Caltech Jet Propulsion Laboratory which I attended last week (May 16-17, 1994). It was sponsored by NASA's Office of Advanced Concepts and Technology, and its purpose was to bring together a group of experts and interested parties to review quantum mechanics and relativity theory as applied to concepts such as space-time wormholes, trans-relativistic physics, spacetime structure, and quantum nonlocality. In other words, we were to review possible physics routes to faster-than-light (FTL) travel and/or communication.

The 13 participants at the workshop were from varied backgrounds: NASA personnel, NASA consultants and contractors, academic physicists, and science fiction writers. Several physicists who also write science fiction were workshop participants, including Gregory Benford, Robert Forward, Geoffrey Landis, and myself. Dr. Gary L. Bennett, a SF novelist and expert on nuclear power systems for spacecraft, was the workshop's official NASA sponsor. The workshop was organized by Dr. Robert H. Frisbee of JPL, with some help from Bob Forward.

The areas of physics covered during the workshop fall into several broad areas: wormholes, nonlocality and other quantum effects, tachyons, and extra dimensions. As often happens when physicists get together, we probably generated more questions than answers, but we made progress. In this column I'll summarize the discussion about wormhole physics that took place on the first day of the workshop. In my next AV Column (February '95) I'll cover other FTL topics discussed on the second day of the workshop.

Constructing Wormholes: At the workshop we discussed two types of wormholes, the "standard" Morris-Thorne (MT) spherical wormhole and the somewhat more housebroken Visser wormhole. Both worm-

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hole types are shortcuts through spacetime, completely consistent with standard gravity theory, that appear to offer the possibility of faster-than-light travel and even time travel.

Michael Morris from Butler University in Indianapolis gave the first AQRTP Workshop presentation. Mike did his Caltech Ph.D. thesis with Kip Thorne on the original formulation of spherical wormholes. Morris-Thorne wormholes, first described in a 1988 paper in the *American Journal of Physics*, are spatial shortcuts that an advanced civilization, one capable of manipulating planet-masses of energy, might be able to snatch from the quantum foam, inflate to a useful size, and stabilize by placing a Casimir-effect spherical capacitor in the wormhole mouth. (See "Wormholes and Time Machines," my AV Column in the June '89 *Analog*, for details). These could, in principle, be used for faster-than-light travel and even time travel.

There are some problems, however, with the MT spherical wormhole scenario: (1) the Casimir capacitor needs to provide a very large quantity of negative energy, perhaps a Jupiter-mass in size, and this must be in delicate balance with the equivalent positive energy of the wormhole's spatial curvature, (2) large radial tension (stretching force) and tangential pressure (squeezing force) develop in the wormhole mouth, which would probably destroy an observer attempting to traverse the wormhole, and (3) recent work by Steven Hawking and others indicate that if a wormhole becomes a time machine, it will probably destroy itself. Morris discussed these problems.

Matt Visser from Washington University in St. Louis was also a participant in the AQRTP Workshop. Visser's wormholes provide the FTL space traveler with a more benign environment. Visser conceives the creation of his wormhole geometry as "cutting similar holes in two regions of space-time and then sewing the edges together." Instead of distributing the curvature of space at the wormhole mouth over a broad region, including the space through which the traveler must pass, Visser would frame a flat-space wormhole connection with "struts" that contain a region of very sharp curvature. The material needed to make the struts is not ordinary matter, but in a sense it is perhaps available.

Over the past decade, cosmologists have speculated about cosmic strings, linear fractures in the fabric of space that are solutions of Einstein's equations. (See my AV Column "Strings and Things," April '87.) The usual cosmic strings are very massive, perhaps an Earth-mass per meter. To frame his flat wormholes, Visser needs a slightly different string solution that has the property of *negative mass*. (See my AV Column "Antigravity I: Negative Mass," July '86). The negative mass of the strut edges (as in the MT wormhole) is balanced by the positive mass of the mouths themselves, leaving the wormhole structure with a relatively small (perhaps zero) mass.

Visser suggests making a wormhole

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mouth in the form of a cube, with flat-space wormhole connections on the square sides and strings as the edges. Each cube-face may connect to the face of another wormhole-mouth cube, or the six cube faces may connect to six different cube faces in six separated locations. The Visser Cube of wormhole mouths is reminiscent of the familiar SF notion of a star gate.

Natural Wormholes: Our technical capabilities at present are not up to the task of creating either MT or Visser wormholes. Therefore, the question of whether they might occur naturally arises. In this context it is very interesting that cosmic strings are a component of Visser wormholes. Cosmologists have speculated that loops of cosmic string might be produced in the early phases of the Big Bang, particularly the so-called inflationary phase when the emerging universe undergoes very rapid expansion. The usual scenario is that if such string-loops were created in the early Universe they would probably oscillate, disperse their large mass-energy as gravity waves, and disappear. However, if a cosmic string had *negative* mass this decay process would not be possible because negative energy gravity waves presumably cannot be generated.

The formation of such negative-energy string loops framing a wormhole during the Big Bang could result in a stable object that had a net positive mass. This, then, is a plausible scenario for the formation of stable natural wormholes that might still exist in our Universe. As this scenario emerged from our discussion, the focus of the workshop turned to the question of how, if such natural wormholes exist, we might search for and find them. And we invented a way.

If a positive electric charge **Q** passes through a wormhole mouth, the electric lines of force radiating away from the charge must thread through the aperture of the wormhole. The net result is that the entrance wormhole mouth has lines of force radiating away from it, and the exit wormhole mouth has lines of force radiating toward it. In effect, the entrance mouth has now been given a positive electric charge **Q**, and the exit mouth acquires a corresponding negative charge **−Q**. Similarly, if a mass **M** passes through a wormhole mouth, the entrance mouth has its mass increased by **M**, and the exit mouth has its mass reduced by an amount **−M**.

In the early Universe these mass changes might create a dynamically unstable situation. If one natural wormhole mouth begins to increase in mass, its twin will correspondingly be reduced in mass until it acquires a net negative mass. The mouth with positive mass will attract more mass to it, while its negative-mass twin will gravitationally repel any nearby mass. Thus, this mass imbalance should grow until it eventually is damped by the growing distance scales from the expansion of the Universe.

The net-conclusion of this line of reasoning is that there might be natural wormhole mouths of planet-size or star-sized negative mass within our

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Galaxy. These would repel nearby masses but, like normal stars or planets, would be attracted to the mass of our Galaxy and orbit around it. The large negative mass of such objects might be exploited in searching for them.

There are presently three groups conducting astronomical searches for non-luminous or dim Jupiter-size masses or MACHOs (MAssive Cosmic Halo Objects) that, if they occur in sufficient numbers, may provide a partial solution to the Dark Matter Problem. (See my AV Column "Searching for MACHOs," May '94.) The groups have all recently reported successful detections. Their technique is to use the gravity field of the objects as a lens that will briefly, over a period of days or weeks, increase the brightness of a more distant background star as the MACHO passes through the line of sight between observer and background star.

At the AQRTP Workshop we realized that a negative mass object would also produce a gravitational lensing effect, but in the form of a diverging rather than converging lens. Thus, the background star should be briefly dimmed or extinguished if a negative mass object passed through the line of sight. During my week stay at JPL I did quick calculation of the shape of this profile. The star intensity first increases, then vanishes, then returns, producing a time profile that is quite distinctive, and if it exists, should be discernible in the MACHO search data. Forward, Benford, and I are now writing a physics paper to publish this new prediction.

* * *

Time Holes and Catastrophe: The original paper describing MT wormholes also described a way in which they could be made into time machines by using relativistic time dilation to create a time difference between one mouth and the other. Hawking has suggested that while nature does not abhor a vacuum she may very well abhor a time machine. His calculations indicate that vacuum fluctuations of drastically increasing energy, rather like the audio feedback we experience with a PA system when we bring a microphone too close to the speaker, will arise just as the wormhole connection becomes "timelike."

This arises because the magnitude of quantum vacuum fluctuation depends on the space-time interval (square root of distance squared minus time squared) around a circuit threading through the wormhole and then back in normal space. As a wormhole becomes a time machine this interval first becomes very small, then becomes zero, and then becomes negative. During this transition in the region near zero interval it crosses what is called "the Cauchy Horizon." There the quantum fluctuations should, according to Hawking's calculations, grow without limit and destroy the wormhole.

It is interesting to note that it is the *transition* through the Cauchy Horizon that produces this catastrophe, not the existence of a time-spanning wormhole. If somehow the time-spanning wormhole (negative interval) could be established, it would

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perhaps be as stable as a space-spanning wormhole (positive interval).

An interesting corollary of this is that even when two wormholes each span a positive interval, a path threading both of them can have a zero interval leading to the Cauchy instability. Visser in a recent paper showed that under certain circumstances the instability might be evaded, but only for very small aperture wormholes separated by a distance approaching the diameter of the Universe. If there are naturally occurring wormholes, it was suggested that because of back-reaction they might arrange themselves to fill all of the available wormhole "space" and to vigorously resist, through quantum fluctuations and back reaction, any attempt to create new wormholes or to significantly alter the space-time connections of existing ones.

Summary: The first day of the workshop provided stimulating discussion about wormholes, both natural and artificial, and several interesting new ideas emerged. We invented a way of searching for natural wormholes, using data that is already available.

From the point of view of SF, new "ground rules" for the construction and operation of wormholes seem to be emerging from the active theoretical work on the subject. Attempting to convert FTL wormholes to time machines may be spectacularly dangerous. Time travelers beware! ■

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I sometimes wonder if one of the politcally correct ideas of the '70s—not giving children toy weapons because it encouraged aggression—might have been a contributing factor to teenagers carrying pistols to school today.

—Grey Rollins

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J. Steven York

CARVED IN STONE

The past may be immutable, but that doesn't mean there's nothing anyone can do about it. . . .

Illustration by Steve Cavallo

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The door of the smart cab hissed open, and Juanita was half out onto the cemetery sidewalk before the smell of the place washed over her. The overwhelming smell was of honeysuckle and sweet, freshly-mown grass, but somewhere under it all, Juanita imagined, and perhaps it was just her imagination, the rancid smell of death.

She looked out across the expanse of manicured lawn, broad shade trees, and carefully tended islands of flowers in red, purple, and white. It might have been a park or a garden, but for the ranks of marble headstones, and the corruption and decay she knew lay only a few feet beneath the perfect surface. Harvey was down there, rotting. *Bastard.* If anyone deserved to be buried in the cold earth and eaten by worms, it was Harvey.

Juanita had queried the cemetery computer on the way from the airport and transferred a map to her hand-link. She knew the way to Harvey's grave. So, why couldn't she move? She considered getting back in the cab and returning to the airport. That would be stupid.

She made a fist and thumped it gently against the side of the cab in frustration. "What am I doing here?"

Two of the cab's eyes swiveled to watch her from a little turret in the cab roof. She wondered if it had heard her rhetorical question, and was trying to decide if it should respond, or if it was merely concerned that she'd damage the cab. She had *asked* it to bring her here, paid it to do so. Now she was paying it to wait, watching her silently with its crystal teddy-bear eyes.

"Is there a problem?" The cab's little-boy voice was gentle and polite. She wished it were coarse and rude. Then she'd have an excuse to get out of the cab. Or to get back in, return to the airport, and leave this place forever.

She'd planned to go to the grave and—what? Dance? Spit? Gloat? It had seemed so clear when she'd finally heard about the car accident—learned Harvey was dead. She'd boarded the boostliner in Seattle feeling such a sense of purpose and satisfaction. She'd maxed all her credits to afford the cross-country ticket, and it had seemed a good investment at the time. Now it had all wilted like a cut flower too long in the Sun.

All she knew was that she and Harvey had unfinished business. She'd never confronted him for the way he'd treated her, or what he'd done to her. She'd filed a police report at the emergency room while they were getting ready to set her arm. While he'd spent the night in jail, she'd had friends pack her things. By the time he had gotten home, she was already on the way to Seattle and a new life. She'd later heard that, without her to testify, the assault charges had been dropped. She'd never had to face him again, and at the time, she'd considered it a victory. Now, she wasn't so sure.

"Wait there," she finally told the cab. "I won't be long."

She was away from the car before she could change her mind, wading out among the headstones, lined up like soldiers at attention. The sound

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of distant voices caused her to hesitate. She wasn't the only visitor to the cemetery today. Half a dozen rows over, she could see three people standing in front of a grave, an elderly man and woman, both dressed in black, and a scruffy teenage boy dressed in jeans and a black leather jacket, a red bandanna tied around his long dark hair. It seemed curious to her that the boy was standing directly on the grave, leaning against the headstone, arms crossed over his chest. He seemed comfortable there, chatting with the old couple.

Things seemed to wrap up, and the couple lowered their heads and turned to walk away. The teen held up his open hand, rotating the wrist in an understated wave good-bye. Then he dissolved. Juanita blinked her eyes just to be sure she wasn't imagining it. The boy turned into a cloud of particles that swirled like a dust devil for a moment before fading away. She held her hand to her chest, feeling her heart pounding beneath the white silk of her blouse. Then she laughed nervously, knowing that the teenager must have only been a DeadRinger.

She turned to the nearest headstone, examining it closely. It seemed conventional enough, an elaborately carved slab of speckled gray granite, engraved with a name and the years of birth and death. There was no other inscription, but that would have been redundant. She stepped closer, spotting the array of lenses skillfully blended into the pattern of the carvings, like the eyes of a camouflaged desert spider.

She edged nearer to the grave, flinching in spite of herself as an elderly black woman materialized in front of her, wrapped in an elaborately patterned shawl of purple and white. The woman lifted her head and spread her arms, like a blooming flower or a butterfly emerging from its cocoon. She looked at Juanita, with eyes the color of chocolate, and smiled.

The effect was startling in its realism, and Juanita felt compelled to say something, even though she knew the woman was just a computer-generated projection. "I'm sorry to disturb you, Ms. Thomas," she had read the name on the headstone, "it's just that I've never been to a place like this before. I've heard about them, seen them on the vids, but never. . . ."

She was afraid somehow that she'd upset Ms. Thomas, as absurd as that seemed. Ms. Thomas was only a sophisticated artificial intelligence, programmed with the voice and appearance of the woman when she was alive, provided with enough information to recognize and respond to family members. She'd heard some of them had more complex programming based on diaries, biographies, interviews with relatives and friends, old vids and photographs, and other information that could be dredged up. But the programming was more expensive than the DeadRinger hardware, so most started out quite simple, learning about themselves from conversations with visitors they recognized as having known them in life.

Thomas leaned toward her, squinting slightly. "I don't know you, do I,

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honey?"

"No, ma'am. I realized what kind of place this was, and I just went to the closest headstone to see. I've never met a DeadRinger before."

Ms. Thomas drew back and frowned. "We don't like that word here, honey. That's just what they say on the vids. We're called 'life memorials.'" The smile returned to her face, and she somehow reminded Juanita of a child who had just done a successful recitation. Then the smile took on a bemused twist. "Did I say that? Darned if they don't put the funniest things in our heads. When Harvey Mendez sold me this plot he never said they'd be putting these things in my head. I don't mind DeadRinger at all. I think it's kind of funny, myself."

"Wait a minute. Harvey sold you this plot?"

"Oh, yes. We have to be reminded of a lot of things, out here in the graveyard, but that's one thing they made sure we remembered, just in case anyone asked." She giggled. "Harvey hated it when I called it a graveyard. 'Memorial park,' he'd say to me. 'Memorial park.'"

Well, it figured. Harvey had always been a salesman, always a hustler. Selling high-tech funeral plots to old ladies who couldn't afford them would have been just like him. "Bastard," she said unconsciously.

Ms. Thomas shook her head. "You don't mean Harvey, do you, honey? It's not nice to speak ill of the dead."

Juanita nodded.

"But he was always such a nice young man. Very serious. He'd come by to talk to me sometimes. He'd talk to all of us down here. I kept telling him he should stop spending so much time down here and find himself a girlfriend."

Juanita flinched at the last suggestion, and found herself rubbing her forearm. "Harvey didn't have much luck with women."

"You don't mean—? Were you and Harvey involved? You did know that—"

"He was here? Yes, I knew. That's why I came here today. And Harvey and I were married once. But things didn't work out. Harvey broke my arm, and I left him."

Ms. Thomas gasped. "Oh, I just can't believe it. You just never know the torment some people have buried down inside."

Juanita's reflex was to be offended by the sympathy the woman appeared to feel toward Harvey, but she suppressed it. It was the reaction most people had when they found out somebody they knew, or thought they knew, was a thug. They'd built up a view of the person in their minds, one that didn't include cruelty and violence. It was difficult to discard that view, and the new information had to somehow be crudely cobbled on. The other alternative was to throw out the old view completely, and to treat the new view as a separate person, Jekyll and Hyde. Or just Hyde, and Jekyll who never was.

Then, abruptly, she remembered that she was only talking to a computer simulation of a person. The illusion was so perfect that she'd forgotten. Did a DeadRinger think like a

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person at all? She shivered despite the warm afternoon Sun. But looking at Ms. Thomas's moist brown eyes, so like her own grandmother's, it was impossible to treat her any way other than as a person.

Is that what had happened to Harvey? Had he just been assigned to go from grave to grave, inspecting each for proper operation? Had he found himself talking to them the way she was now? All she'd wanted was a little information. All she'd wanted to know was what it was like to talk to a dead person before she had to talk to *him*. It was only coincidence that she'd found one that knew Harvey. Of course, it was possible that they *all* knew Harvey here. What would happen if she went down the row of headstones, talking to each Dead-Ringer? Would each have their own image of Harvey, all different, all false?

Ms. Thomas stepped toward her. "Is your name Juanita? Harvey used to mention you sometimes when he came by here. He talked about driving you away. Said something about not deserving you. I never understood that till now."

Juanita suddenly felt uncomfortable. She realized that she was hearing things that didn't fit *her* view of Harvey the monster, Harvey the ogre, Harvey the thug, and she didn't like it. "It's been nice talking to you, but I really must be going." Instinctively, she reached out to touch Ms. Thomas's arm, but her hand went right through, causing the images to swirl like smoke in a draft.

To her amazement, Ms. Thomas giggled. "That tickles, honey. Of course, I can't really feel it, but it tickles just the same."

"I'm sorry. I should really go find Harvey."

Ms. Thomas pointed up the hill. "He's up at the crest, straight up from the lily pond. Of course I can't go visit, but he pointed it out one day when he was here, and my daughter came to visit the day they put him down. I watched the service from over here."

"Thank you, Ms. Thomas. It was a pleasure meeting you."

She smiled. "Drop by to talk any time."

Juanita remembered the teenager's sad little wave, and suddenly felt guilty. "Will you be—OK? I mean, you won't be lonely or anything?"

She dismissed the notion with her hand, like swatting a not especially annoying fly. "My people come to visit me all the time, and there are plenty of lonely folks who come to the cemeteries just to talk. There's always some company about. And besides, when there's nobody here, it's just like sleeping." She continued, without a trace of irony in her voice. "That's something we dead folks do well, sleeping."

The hill beckoned Juanita, even as part of her screamed to turn back. Part of her was still afraid of Harvey, even though she knew he was dead in his grave. Part of her was afraid to see him, to hear his voice, even though she knew he couldn't touch her, even if he wanted to. But she could talk to him. Tell him how angry she was, how she felt about him. She

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could do it, unafraid of repercussions, knowing Harvey could never hurt her again.

The plot was in a lovely location. She could look out past the cemetery, over the forests of dark green pine, and down to the river a few miles east. Harvey had certainly gotten a choice plot for himself. Perhaps he'd used it as a sales tool. Juanita could imagine that, proof to his gullible pigeons that he believed in his product. Of course he could have lied about owning a plot, but that wasn't the man Harvey was. He could have been caught at that.

That was one thing you could say for Harvey, he never lied unless he thought he could get away with it. He used the truth like a tool, turning it to his advantage, like he'd gained Ms. Thomas's sympathy over his "lost love."

But if the location was choice, he seemed to have cut corners elsewhere. The headstone was small and simple, a dwarf in the shade of its more spectacular neighbors. Had he cut corners on the programming too? Juanita wondered just how much of Harvey there would be left to confront. For the first time, she wondered if the DeadRinger would recognize her. They were always programmed to recognize family, but Harvey would have had no reason to think she'd come here. Or would his ego have let him assume otherwise? There was only one way to find out.

The headstone was only a few meters away. She knew that only a step or two would take her within its range of sensitivity and activate the DeadRinger. Only a step or two to see Harvey again.

Those steps seemed both uncomfortably close, and painfully far. It was like standing on the ledge of a tall building and looking down. She took a deep breath and stepped forward.

The air in front of the headstone shimmered, particles swirling upwards as though dust were rising from the grave and reassembling into the man. Juanita felt a certain sense of power, even as he began to take shape, in that she could take a few steps back and return him to dust. It made seeing his familiar face a little easier to take.

He looked just as he had the last time she'd seen him, not a day older. His dark hair was longer, standing high on his head like wind-blown wheat, but the face was the same—the blue eyes, the high cheekbones, the full, sculpted lips, the jawline just a little too strong for perfection. It was easy to see how she'd once been attracted to him. Now she could look into those eyes and imagine only anger, hatred, and violence.

Now, he only smiled, gently, warmly, like when they'd first been together. "Juanita! You came! I wondered if you'd come. We have so much to talk about."

Part of her wanted to call him a bastard, that word that had escaped her lips so many times at the thought of him, but she didn't. Instead she just stared at him, looking for some trace of the meanness that she had known there, and not finding it. She realized, with some disappointment, that his programming was limited. Despite

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the smile and fond greeting, he seemed hardly to know her at all.

She tried to think who would have visited him here: his mother, a doting little woman who lived only an hour or so away in Atlanta, his older brother Carlos who worked for one of the vid networks in the city, and his older sister, Etta, an ice queen who designed thought-pumps for a company in Columbus.

They'd all thought highly of Harvey, in different ways. If that was where he'd learned about himself, he'd certainly gotten an unbalanced view, one that probably didn't include Juanita. Carlos hadn't liked her since she'd refused his pass at a Christmas party eight years ago. She and Etta had never gotten along, and Harvey's mother, though she'd always been friendly, had turned on her like a snake when the marriage went sour. They'd all been glad to be rid of her, and she couldn't imagine them bringing her up now.

"You don't even remember me, do you, Harvey?"

The smile faded for just a moment, then returned full strength. "Of course I do. You're Juanita. We were married."

"We were married. What else?"

Harvey looked away, smile fading completely this time, and his image seemed to get grainy, as though her question had overwhelmed the computer, for a moment drawing back the curtain of reality. "I'm sorry, Juanita. Dying is a difficult process, and I've forgotten things. I only remember that we once felt strongly for each other. Can't we reminisce about those times? Tell me about how it used to be."

Juanita felt her body tense, felt herself swept away on a wave of emotion she hadn't seen coming, felt pressure building up inside her, like a teakettle coming to boil. He was doing it again—smooth, charming, spinning a web of lies. But this time she knew, knew who he really was. Suddenly she was moving toward him, no longer hesitant, no longer afraid. In a moment she was on him, swinging her arms, lashing with her fists, kicking. But she felt nothing as her flailing limbs passed through him, scattering him into condensed clouds that swirled and reformed, like a flock of birds avoiding a hawk.

The only satisfaction, the only satisfaction at all, was that Harvey reacted to her blows, only not the way she wanted. He was laughing, pulling away, trying ineffectively to block her with his arms. "Damn it, Juanita, *stop!* That *tickles!*"

She did stop, stepping back just a step, to see what she had done. Harvey was still laughing, trying to compose himself, or at least, the computer was putting on a pretty good show. How much of this was show, pre-programmed reactions to make the visitors happy, and how much was real personality, recreated in the machine? Did it matter?

She moved half a step closer, getting in his face, arms back, chest out. "Hit me," she said. "I'm not afraid of you, Harvey. Hit me!"

Harvey just stood there, looking bemused, shaking his head.

"Damn you, you bastard, hit me!

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Just like you used to! Like the time you broke my arm! Have you forgotten that too?"

But it seemed that Harvey had. He held his hands out, and she saw that his lips were moving, but there was no sound. The image shimmered, then seemed about to break up entirely. She remembered what she'd been thinking earlier, about how people had to throw out their vision of a person when presented with anomalous information. That was fine if that vision was someone else, but what if that vision was all *you* were? This thing wasn't Harvey, she knew that now, and it had never hurt her. She watched it, breaking up almost completely, arms outstretched toward her. To whatever extent this thing was conscious, she was killing it.

"You didn't hit me, Harvey. I just said that because I was angry. I'm sorry." And with her words, she healed him. Suddenly the image was whole, and Harvey was smiling as though nothing had happened.

"I understand, it must have been difficult for you, Juanita. I can't blame you for being angry at me."

She drew her arms across her chest, and thought of the real Harvey, cold and buried in the ground under her feet. She thought of him and felt nothing. He was buried, old business; let him stay that way.

"I have to go, Harvey. I just had to say good-bye. I won't be back."

Harvey smiled sadly. "I understand, it's that way sometimes. Good-bye, Juanita."

She started to walk away, but turned for one last look at the Harvey that never was, or perhaps the Harvey that might have been. He was all the things she had once loved, with none of the anger, none of the greed, none of the hate. He was Harvey filtered through the hearts of the people who had cared for him, who had never known his dark side. He was perfect, and he didn't exist. All that was left of Harvey was a kaleidoscope of memories, all equally right, all equally wrong, as illusory as the people who inhabited this cemetery, and just as real.

She walked down the hill, not looking back. Sometimes, she would pass too close to a headstone, and she would smile and greet the person who materialized there. Let people have their illusions. Sometimes illusions were a good thing.

The cab was waiting, but first she had to stop and straighten things out with Ms. Thomas, to restore her old image of Harvey. She'd have to lie, of course, tell her that Harvey hadn't hit her at all. What harm could it do? It was old business.

Let this be the place where the past was buried. ■

Minds that have nothing to confer find little to perceive.

—William Wordsworth

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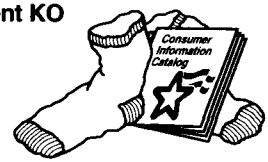

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TODAY'S THE DAY

Stop Smoking.

American Heart Association

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Tuesday morning, July 27, 2047, should have been the beginning of the most triumphant period of Royce Hunter's life. And—for almost forty-four hours—it was. In the forty-fourth hour the nightmare began.

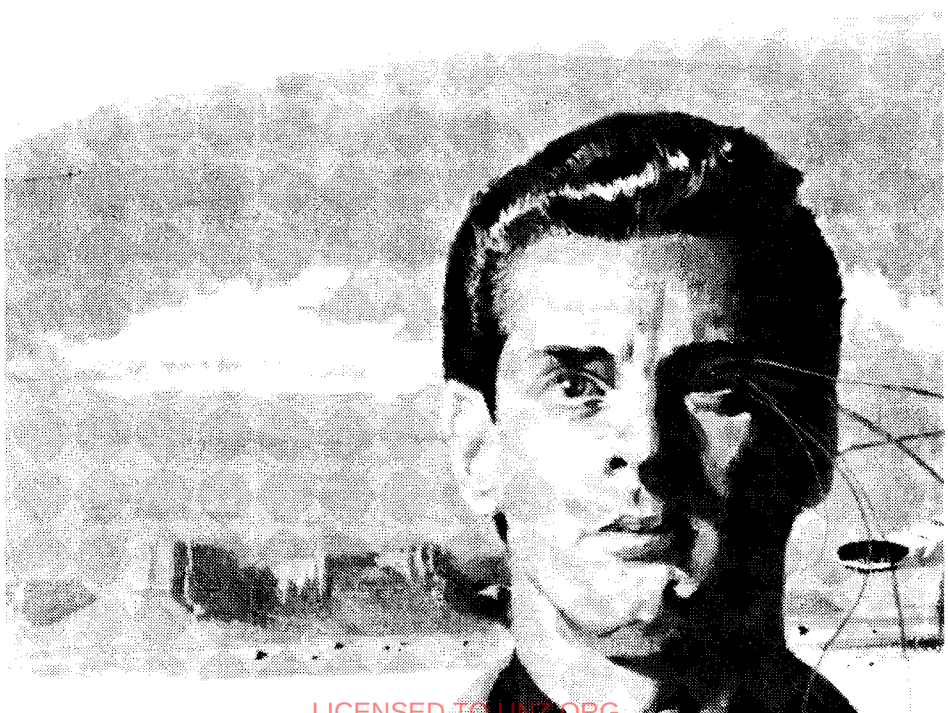
It started with a minor blip on the *Titan Explorer*'s radar screen. Six days earlier the *Explorer III* had passed the invisible halfway point between the orbits of Jupiter and Saturn and was now within a hundred million miles of its goal, a landing on Saturn's largest moon. Earth was more than eight astronomical units away, nearly three-quarters of a billion miles.

More relevantly, with the Asteroid Belt and its millions of fragments of nickel-iron rock also five AUs behind the ship, it was almost inconceivable that a wandering body could be this near the *Explorer*. The object on the screen was a mere .0019 AUs away, something less than the distance from Earth to the Moon.

The ship's AI control program pondered the situation, noted that its two human directors were still deep in REM sleep, and decided to do nothing more for the moment.

Twelve minutes later, unseen by either Stefan Lubchek or Nancy Chang, the blip abruptly changed course and moved to intercept the *Titan Explorer III*.

Now the two sleeping crew members were alerted by the ship's control program. Natural bodies, even tumbling hunks of asteroidal rock or meteorites from beyond the Solar System, follow a ballistic course



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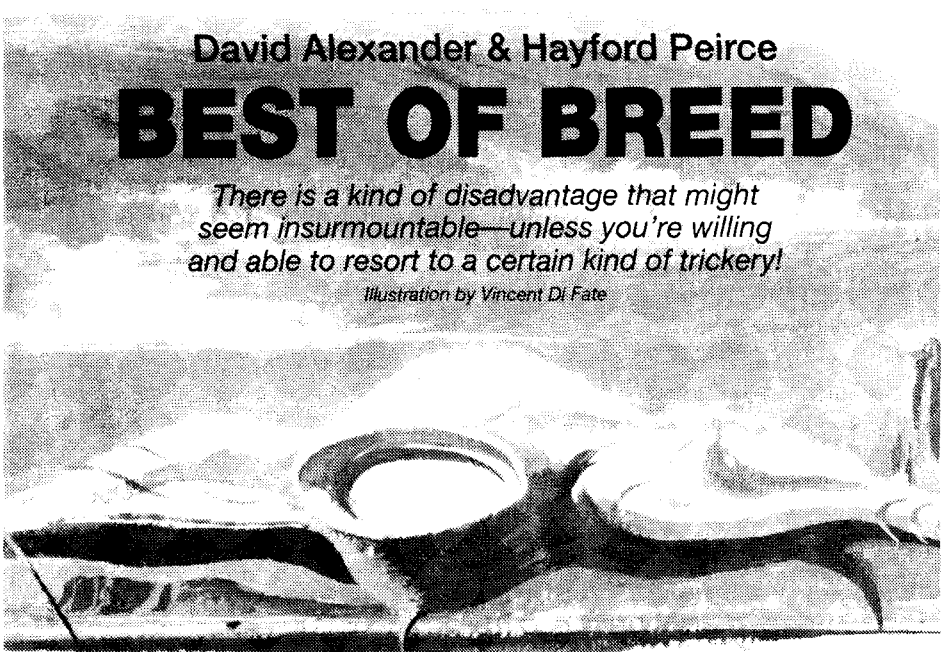
whose only deviations are the result of gravity and the pressure of the solar wind. Without doubt, the computer reported, the approaching object was, if not actively manned, at least controlled. The program also noted that it had no record of any Earth-built ship closer than those at Port Dexter on the Moon.

It took 69.7 minutes for a radio transmission to reach Earth from the *Titan Explorer III.* Ninety-seven minutes after the computer first roused Major Lubchek and Lt. Commander Chang, Royce Hunter stumbled groggily from his bed. Bleary-eyed, he waited for his coffee to brew while he stared through the kitchen window at the infinite canopy of stars shimmering in the clear air of the Nevada desert. Now, it seemed, those stars were coming to man before he could go to them.

Hunter, the director of OSEP—the Outer System Exploration Program—took his first sip of scalding coffee, shook his head at the wonder of it all, and debated reawakening Caroline. No, he decided, there would be plenty of time for celebrating once they knew exactly what they were dealing with. Let her sleep.

Two hours and twenty minutes after the first radar contact, the object matched course and speed with the *Titan Explorer III.* The two crew members crowded against the forward viewport, their eyes wide, their hearts pounding. The lumpy gray shape before them was clearly an artifact—and equally clearly not the product of human hands or minds.


David Alexander & Hayford Peirce
BEST OF BREED
There is a kind of disadvantage that might seem insurmountable—unless you're willing and able to resort to a certain kind of trickery!
Illustration by Vincent Di Fate

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A hatch opened and a space-suited arm beckoned in what they provisionally took to be a universal gesture of invitation. With no regard at all for what he knew his superiors on Earth—principally Royce Hunter—would have ordered him to do, Major Stefan Lubchek donned his EVA suit, tethered a cable to the outer lock, and launched himself across the fifteen yards that now separated the two craft. To hell with Nevada and Royce Hunter—this was his chance for immortality! His copilot and longtime companion, Lt. Commander Nancy Chang, began transmitting a running commentary to program headquarters.

Nine hours later Major Lubchek returned to the *Titan Explorer III* and began to transmit his own encrypted report. Earth's last major war lay more than a century in the past and acute paranoia was no longer a global state of mind; security—by old-fashioned standards—was consequently minimal. The official inquiry later established that the transmission was received by hundreds of amateur and professional space watchers and that its archaic code was quickly deciphered by at least four different supercomputers.

Royce Hunter had hardly slept in the nearly two days since being told of the alien presence in the Solar System. Now, forty-four hours later, light-headed with a mixture of sleeplessness and jubilation, he staggered blearily across his carport and into the kitchen—and Caroline's welcoming arms. It was ten o'clock at night, normally far past their bedtime, but tonight Maureena and Charlie-Boy had been allowed to wait up for him.

"Tell us about the Men from the Stars," begged Maureena, his seven-year-old. She tugged frantically at Hunter's shirtsleeve, while the five-year-old wrapped himself python-like around his leg.

"Have you got a picture of them, can you—"

"Hush," interrupted their mother. "First let Daddy sit down for a moment and then—"

Royce Hunter heard the unmistakable sound of glass shattering in the living room, followed almost instantly by a thunderous explosion, a single flash of terrible, blinding light, and the dreamlike sensation of seeing the kitchen wall expanding toward him like the opening petals of a gigantic flower.

It was three days before he awoke to learn that he was in the base hospital, that his wife and two children were dead, and that he himself was now missing both arms, both ears, one eye, and one leg. It was, the doctors said, a miracle that he was still alive.

Alive. In the days to come, Hunter often wondered if he was or not. And then wished he wasn't.

When he was coherent enough to dimly understand that he was in the grip of near-catatonic depression, he demanded that a VR socket be installed in his head. After that he was content to retreat into the blissful world of virtual reality. There life was an endless laze in the shade of a luxu-

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riant sycamore. From his hammock a hundred yards away, he watched Maureena and Charlie-Boy splash in the swimming pool under Caroline's watchful gaze. Their shrieks and shouts drifted toward him on the soft breeze as he took another sip of lemonade. Languidly he replaced the glass in the drink-holder, then closed his eyes and drifted off to sleep with his children's laughter ringing in his ears.

On the fourteenth day a new voice intruded into the dream-world of hammock and children, that of Chalukya Rashtrakuta, the program's chief of staff. The voice had been calling his name for what seemed like hours, whispering softly but relentlessly into the artificial ear that had been fused directly into his auditory system.

"Go away," muttered Hunter, intent now on the image of Maureena chasing Charlie-Boy around a plastic flamingo.

"We need your help."

"I don't want to help."

"What *do* you want to do?"

"Nothing. No, to die. Go away."

Rashtrakuta refused to go away. "They caught the people who threw the bomb. There were over two hundred of them. You and your family weren't the only ones. They were trying to destroy the entire project. Besides the half-billion dollars in physical damage, they killed forty-seven of us: Hirakawa, Hardecker, Monico, Fajardo, Cheun, Stumpel, Parson, Dmitriy, Sally Pack—"

"Sally Packworth? She's dead too?"

"Yes. Along with Hutchins, Rossi, Wengel. . . . " The terrible litany went on and on.

"Why?" whispered Hunter finally, unaware of the tears that were flowing from his one remaining eye. "Why?"

"A religious sect from the Oregon rain forests. Somehow they got into someone's computer who had already tapped into ours. They were convinced that we were responsible for bringing Satan to Earth."

"Satan?"

"The Trajendi."

"Oh." Hunter was silent for a long time. "Maybe there *is* a Satan, you know. If there weren't, how can you explain things like this? Caroline, Maureena, Charlie-Boy?"

"I can't," said Rashtrakuta harshly. "No one can. But in the meantime, we need your help."

"Why? What can I do?"

"I think we need you to help save the human race."

An awful cawing sound escaped Hunter's twisted mouth. "Me? You want *me* to help you save the human race?" The terrible sound repeated itself. "I can't even save myself."

Hunter sank back into his bed, exhausted by his outburst.

Rashtrakuta ignored his words. He began to read Hunter the transcripts of the long-distance debriefing that Lubchek had been undergoing for the last two weeks as the *Titan Explorer III* returned to Earth with as much speed as possible.

Hunter closed his eye, turned his head away, and tried to ignore the soft flow of words.

Caroline, he cried despairingly to himself, O Caroline, why aren't you

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here?

Thirty-four days after First Contact, Royce Hunter attended a teleconference with the five most powerful people on Earth: the President of the United States, the Prime Minister of China, and the two men and one woman who comprised the Council Members of the Executive Committee of the Conservancy. Everyone except Hunter was in a Conservancy room overlooking Lake Geneva. Hunter was still in the hospital at Nellis Space Base in central Nevada. A black patch covered what had once been his left eye. None of the others could keep their eyes on the disfigured face after the initial seconds of shock.

"They'll be here in seventy-eight days," said Hunter, turning his one eye to the image of the Councilmember from the European Protectorate, "and that's all there is to it."

"Yes, but I still don't see why you attach such great importance to—"

"Councilman Tournet, four lunar months was the most time that Major Lubchek could get for us. The Trajendi were very insistent. To put it bluntly, the major's meeting with the Trajendi was *not* a negotiation." Hunter's eye swept the five faces. "You have all seen the transcripts. The Trajendi didn't *ask* if they could open diplomatic relations with us. They merely informed us that they would shortly be presenting their credentials. And told us when and where they would be arriving. Luckily, Major Lubchek was able to get us a little extra time."

"We are all well aware of that, Mr. Hunter," said Prime Minister Lii. "We have, in fact, been thinking of very little else for the last five weeks."

"So I imagine. I myself have been thinking of *nothing* else. The first and most obvious conclusion I came to was that the Trajendi were very astute in how they carried out this first contact. It was obviously carefully planned."

"Why do you say that?"

"Isn't it evident? It was carried out in a way that: A) would not cause a panic; B) could not be misinterpreted; and C) could not be ignored."

"Still, that's no reason to be so stridently insistent on addressing the five of us together," growled Councilman Gupta of the Indian Confederation. "Do you *really* think you can frighten us any more than we already are?"

"We'll just have to see, won't we?" Hunter's bleak eye moved on to President Clayborn. "The next thing that strikes me about the transcripts is the quick wits displayed by Major Lubchek in getting the Trajendi to agree to this long a delay in coming to Earth. I am most impressed by his behavior. I only wish he could have gotten us four years instead of four months."

The Councilwoman who represented the Pan African Independencies, Katerina Moguiba, tapped her stylus irritably. "Mr. Hunter, I certainly understand the need for sufficient time to arrange the protocol for their visit, but don't you think four years would be a bit excessive?"

"Madam Moguiba," said Hunter, not troubling to keep his tone from sounding as if he were talking to a

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backward child, "protocol and public relations are of no importance in this matter. My—our—only concern must now be prevention of the subjugation of the human race."

"Subjugation of the human race? By one spaceship? By bug-eyed monsters? Death rays? The War Of The Worlds? Surely you can't be serious, Mr. Hunter!"

"They certainly sound peaceful enough to me," said Councilman Tournet. "If you boil down everything they discussed with Major Lubchek, what it comes to is that they want to discuss what they—and we—call the normal aspects of contact between peoples: immigration control; diplomatic immunity; import and export duties; landing areas for ships; quarantine procedures; contractual frameworks; a medium of exchange; proscribed substances; et cetera, et cetera, et cetera. They sound exactly like three businessmen going from Brussels to Ecuador and trying to develop new markets. What could you possibly find frightening there except for the simple fact that they have come to us from the stars in a machine that is obviously faster than light?"

Hunter sighed and turned his head in the direction of Councilwoman Moguiba. "Tell me, Madam Councilwoman, what happened when the white man came to Africa?"

"That's a completely different situation. We . . . Earthans, I suppose you should now call us, are highly civiliz—"

"I'm sure your African ancestors thought that they were highly civilized. Just as I'm sure the Incas thought *they* were civilized. And the American Plains Indians thought *they* were civilized. The Chinese and the Japanese, of course, *knew* that they were civilized and that the European intruders were long-nosed barbarians. And what good did it do any of them? They were all of them confronted by cultures which were more technologically advanced; more scientifically advanced; more governmentally, economically, and socially advanced. More advanced in information systems; more advanced in communications systems; more advanced in the sense of a more widely diverse philosophical and cultural pool. And, in a real sense, just plain smarter."

Councilwoman Moguiba exchanged angry looks with Prime Minister Lii of China and Councilman Gupta. "This is an encredibly bigoted and racist attitude, Mr. Hunter, and one that has been completely—"

"Europeans could conceive of steamships and electricity and calculus. The people they confronted could not. Europeans could conceive of different political and cultural systems. The native peoples they subjugated could not. Europeans had vast libraries; they had trained specialists whose life's work was studying small, arcane areas of abstract learning and making the results of that study socially useful. The peoples they conquered had none of those things. In the case of the American Plains Indians, they didn't even have a written language. For several centuries it was simply no contest." Hunter's voice was cold and flat. "And this relatively

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small band of Europeans conquered the world. Call the facts racist and bigoted if you like: it doesn't change them."

The President of the United States rapped a knuckle against the table. "There is, I hope, some point to your harangue?"

"Yes, Mr. President, I'm just about there. Organically, the Asians and the Africans and the Amerinds had essentially the same physical brain to work with as the Europeans. The Europeans' advantages were cultural and technological."

Hunter's deformed body shifted restlessly on the bed, his blotchy face thrust forward. "These aliens, however, the Trajendi, not only have the same advantages over us that the eighteenth- and nineteenth-century Europeans had over the native peoples with whom they came into contact; they have something else as well."

"Something *else?*" snapped Councilman Tournet. "What else, Mr. Hunter?"

"Isn't it clear from Major Lubchek's debriefing? No, Rashtrakuta told me it wasn't, at least not to the people who really counted. That's why he pulled me away from—"

"What *are* you talking about?"

"Just this: It is quite obvious that the Trajendi are smarter than we are."

"Ridicu—"

"How can you—"

Hunter turned his head away until silence fell. "One can measure intelligence in many different ways, each of them with its own limitations. There are gross measures such as the amount of brain tissue per kilogram of body weight; the relative complexity of the synaptic connections; the number of variables that can be simultaneously considered in solving a problem; the speed of manipulation of abstract concepts; the ability to generalize successful solutions from limited factual data points, to name only a few."

"Under these strictures," replied Deputy Tournet after a moment's pause, "the dolphin is smarter than human beings. They certainly have bigger brains per kilogram of body weight. And yet we *know* that they are not smarter than we are."

Hunter's eye was unblinking as it turned to the councilman from the European Protectorate. "Generally speaking, brain size is only a very rough indicator of intelligence. *How* the brain is organized internally is at least as important as how big it is. Dolphins, by their very nature, are obliged to perform extremely complicated sonar-tracking calculations in order to flourish in their particular environment. They are also required to compute the true positions of objects across a distorting water-air barrier. They furthermore have to process a great deal of data that are based on odors. Their brains *are* proportionately larger, yes, but much of that extra size is 'hardwired' solely in order to perform these extremely calculation-intensive functions.

"When you take those functions away, what's left is, in fact, far less than the mass of a human brain." Hunter's right shoulder hunched and his face grimaced—he had attempted

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to raise a finger on the end of an arm that no longer existed. "And before we go on to any other analogies, let me just say that the great apes do indeed have reasonably good-sized brains, but that the synaptic complexity per cubic centimeter is far less than that of humans."

"And what has this to do with the Trajendi?" asked President Clayborn.

"Well, we obviously haven't had the opportunity to dissect a Trajendi brain, but judging from the drawings and descriptions that Lubchek sent back, their cranial capacity may be substantially greater than ours. Besides, Lubchek himself is absolutely convinced that they are the smartest beings he's ever run into, and Major Lubchek has an IQ of at least 165. We don't send dummies into space."

"But how could he possibly tell that in such a brief meeting?" Councilwoman Moguiba demanded. "I've studied the transcripts and—"

"Nine hours is *not* a brief meeting. Moreover, he kept his eyes open and asked intelligent questions. Remember, the Trajendi didn't let him bring in any recording equipment or anything else that might possibly have been a weapon, so everything that he's told us during the debriefing is based solely upon his memory.

"Lubchek says they discussed mathematics, set theory, game theory, classical mathematical puzzles —weighty topics for three merchant seamen from Brussels come to sell trinkets to the Indians! He swears they tried to explain how to solve the three-body problem—and that their explanation *almost* made sense to him. Except that five minutes later he couldn't reconstruct the logic. He asked about their governmental systems and they gave him a ten-minute lecture about something called the 'Set Theory Of Sentient Interaction Protocols.' Once again, it *almost* made sense to him. And before you say it, no, they weren't giving him a line of double-talk. Lubchek is a very, very smart man, certainly smart enough to know the difference between something being made up and something that makes sense but which he just isn't able to understand.

"Ladies and gentlemen, we have to face the fact that at least on a cultural and scientific level, and very possibly on an organic level, the Trajendi are simply *smarter* than we are. In any negotiation between them and us, we will lose, and we will lose big."

A long silence filled the room in Geneva. Finally Prime Minister Lii spoke.

"With no disrespect to your Major Lubchek, Mr. Hunter, the gentleman may have an Intelligence Quotient of 165, but that does not make him the smartest person in the world. Far from it. In China alone we have many, many people who are certified geniuses who can competently represent the human race in dealing with these Trajendi."

"Madam Prime Minister, geniuses are generally brilliant in one particular field, maybe two, possibly three, but *not* in general intelligence. No matter how brilliant Albert Einstein was in physics, I wouldn't want him to represent me in negotiations with a car salesman for that new Scepter

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3000 in the showroom window."

"Yes, but—"

"And what if these particular Trajendi are actually just of *average* intelligence as their race goes? What if they really are just the equivalent of commission salesmen, free-lance contractors, railway purchasing agents, backwoods scouts like Daniel Boone? If that's the case, then who's going to be following along after them? We can't even guess at their long-range motives, at the big picture. In the next three months, they could sucker us in ways it might take us a century or more to figure out."

Councilman Gupta snorted disdainfully. "Mr. Hunter, your parochial fears—"

"How long did it take the Cheyenne or the Apaches to understand what had *really* happened to them and what they would have to have done in order to avoid all the traps their negotiators fell into or ignored? What did *they* understand about copper mining, or riparian water rights, or the difference between an option and a contract, or the value of oil and gas leases?"

Councilman Gupta made an angry clucking sound. "Let me just say, Mr. Hunter, that we naturally checked on your medical status before agreeing to this meeting. I don't recall the precise medical terms, but it appears that you are suffering from acute depression and an active desire to be left to vegetate in a world of twenty-four hour virtual reality. These are hardly credentials to compel us to take you seriously."

"Yes, I *am* depressed by the death of my wife and children, terribly so, more so than I can possibly express. But that makes me *more* determined to do whatever I can to prevent suffering for other people's families. I value human life more now, not less."

Councilman Gupta snorted again. "On the contrary, I think you're sounding just like the very people who blew you up: All-mighty Satan is on the way, and there's nothing we poor little humans can do to prevent it."

Hunter's mouth twisted as he struggled to hold back an angry retort. "All I'm trying to do," he said finally, "is to keep *them* from doing to us what the British did to India. I would have thought that you, of all people, would be a little bit more understanding."

Prime Minister Lii nodded curtly. "All right, Mr. Hunter, let us stipulate for the sake of argument that every single thing you have just said is actually correct. Where does that get us? And, more importantly, what do you propose to do about it?"

Hunter's head shifted against his pillows. "It's obvious: We need to have someone much smarter than any of us here in this room represent us in our negotiations with the Trajendi."

"But you've already argued that no humans, not even *geniuses*, are equipped to do that."

"Humans, at least humans in the sense you mean, are *not* capable. Let me put it this way: let us say that Councilman Tournet here owns the smartest French poodle in the world. This poodle is a genuine marvel. If

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you ask it how much two plus three is, it will tap its paw five times. If you point to the Sunday paper and ask it to bring you the comics, it will do so. This is, in fact, the smartest dog in the entire history of the Universe—but, after all is said and done, it is *still* a dog. It is limited by its physiology, by its genetics, by its very nature. And no matter how hard it tries, it can never be anything more than a very, very smart poodle—which is to say retarded, almost cretinous, by human standards. No matter what it does, that dog has no intellectual chance against a human being—at least in anything not involving smelling or barking."

Once again Hunter's grotesque body stirred uncomfortably in his bed. "Ladies, gentlemen, I am absolutely convinced that as matters now stand we have no chance at all in negotiating with these Trajendi. But unlike dogs, the human race *can* augment its intelligence. We can *build* a better human—one that may be able to keep up with the Trajendi."

President Clayborn stared at Hunter blankly. "You're saying that we can build a better human in the next three months? What are you talking about?"

"I mean that we can build a neural-net computer of vast complexity and link it, biologically, with a human brain. The brain will supply the input-output functions, the self-awareness, and general reasoning; the neural-net machine will provide the data access, the computational speed, and the multivariable reasoning. With luck the combination might allow us to hold our own. I'm not a computer expert, Mr. President, but I have discussed this with people who are. They suggest a connection machine using at least 1,271 POP Chip processors, a high-speed data transmission protocol, and a silicon/biological interface chip implanted in the host subject's brain. Which means, of course, that as a first step we're going to have to recruit a highly specialized team to build such a computer at emergency speed."

"POP Chip computers?" muttered Councilman Tournet into the silence that followed. "What precisely does that mean?"

"Parallel Optical Processors. They were actually developed forty or fifty years ago, at least the first ones were, but with all the anti-science hysteria of the Black Years, work on them pretty much fell into abeyance. And when it was picked up again, the Conservancy took it entirely under its own wing. Even now we'll need a special order from you in the Executive Committee in order to get any cooperation from the Classified Projects Agency."

"There are perfectly good reasons the CCPA has kept this technology under wraps," blurted Councilwoman Moguiba. "And this is one of them. What you suggest is *unthinkable!* No sane person—"

"Madam, I admit that this is a desperate plan which will most likely fail, but I see no alternative. The fate of the human race is in the balance. Let me ask you this: after all the years it has taken the people of Africa to rise from the slavery and domination

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which they endured, are you personally ready to let them slide back into that state of subjugation? Will you let them lose everything they have gained to yet another race of imperialists?"

"But who would do it?" the Councilwoman asked finally.

"Why, me, of course," said Royce Hunter.

It was almost two o'clock in the morning when Jacob Lattyak slumped down across from Hunter and wearily lifted his fourth cup of coffee of the night to his lips.

Hunter looked up from the small ground-effect machine in which he sat. Artificial arms had restored a semblance of his former bulk and his surprisingly lifelike hands moved restlessly over the machine's controls. "So, Jacob, can we do it?" he demanded, taking a dainty sip of his cup of lukewarm tea. His insides were far from being what they had been before the attack—and, he knew, they never would be.

"The Project Saber machine we got from the CCPA is a pretty good start. Nothing on the scale we need, of course, only seventy-five processors, but it's a beginning."

"You can give me the technical play-by-play later. Can we *do* it?"

"Maybe."

"When will you be able to give me a firm answer?"

"Two months."

"In two months the Trajendi will be landing in Nevada."

"Exactly my point." Lattyak shook his great head. He was a vast untidy bear of a man with a Viking's mustache and a dense mop of shaggy blond hair that fell past his shoulders. His disheveled bulk made the crowded laboratory on the perimeter of Nellis Space Base seem even smaller than it was. "The best I can say is that we have a chance. We won't know if we can do it until we do it. I can probably, almost certainly, tell you 'No' before then. For a 'Yes' you will have to wait until we succeed."

"Jesus, Jacob, I don't have the energy for all this hairsplitting. What do you personally think?"

"What do I *think?* Now, that's a different question." As usual, the neurocyberneticist ignored the sour grimace that twisted Hunter's lips each time Lattyak used this favorite expression. "OK, I'm tired too. But yes, I *think* we may be able to do it. We've got a good start here—they built a good foundation." He gestured to the far end of the laboratory where seven technicians in white smocks huddled over the just-delivered computer like solicitous mother hens.

"Although this is only a seventy-five processor machine," continued Lattyak, "the architecture will easily support a 1,271 array. They designed it on a multi-bus principal. Each chip connects to a common, ultra-high-speed optical bus which connects all of the chips with common memory and all peripherals. High-speed physical shared memory can go as high as 640 billion bytes. Each processor has 64 million bytes of local memory and its mass storage memory is essentially unlimited. The common bus con-

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nects each chip directly with fourteen adjacent chips."

"Fourteen?" Hunter repeated, his forehead wrinkled.

"Think of a cube with a chip at the center. Lines to the chips at the corners make eight connections. Lines to chips at the center of each face make six more connections, for a total of fourteen.

"Where the people at CCPA really got it right was with the OS, the operating system. It's configured to dynamically allocate processes to the chips based upon need. If, for example, the machine was asked to calculate the position of every single rock in the Solar System in real time, it would figure out how many processors it would need to do the job, then associate them as a work unit which it would treat as a named object called NumberCrunch or whatever.

"Within itself, the NumberCrunch work-unit would operate as an independent neural net. It would divide the problem among its processors, which would communicate directly, processor to processor, using local memory. When the problem was solved, NumberCrunch would pass the results to the common memory over the optical bus. It's almost infinitely scalable and very flexible."

"It *sounds* like it ought to work," admitted Hunter, his GEM jerking erratically back and forth as he continued to tinker with the controls.

"Look, Royce, we can build the processors and tie them in. That's just hardware. Natural-language parsing software has been around for decades, so talking to the machine will be absolutely straightforward. The general-purpose database look-up and number crunching programs are already built into the system."

"But—"

"But will it be able to derive intelligent answers to generalized questions? Will it be able to take the initiative in making crucial connections between varied data inputs when no question was even asked? Will you be able to use it in real time? I simply don't know."

Hunter fiddled with the controls of his go-buggy as he pondered Jacob's concerns. The GEM rose a few inches from the floor and began to turn slowly clockwise. "How fast can you add the extra processors to the bus and install a VR I/O port?"

"Working three shifts and sleeping on cots in the corner, a week, nine days at the outside."

"Well then, I guess that in a week, nine days at the outside, you can plug me in and we'll find out whether it works or not." Hunter's artificial hands tightened on the go-buggy's controls and he moved smoothly out into the hallway for the trip back to his own cubicle and his VR input—where Caroline and Maureena and Charlie-Boy waited for him.

"Are you sure you want to do this?" Lattyak demanded almost angrily, an enormous hand twisting fretfully at his mustache. It was as close as Hunter had ever seen him come to nervousness.

"It's a little late now to change my mind, don't you think? Go on, Jacob, complete the link."

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With a final scowl, Jacob Lattyak entered the security code that activated the connection between Hunter's VR socket and the rebuilt Project Saber computer.

As far as Hunter was concerned the result was spectacularly unremarkable. "Is it on?" he snapped. "What's happening?"

"The OS is up and running. Ask it a question."

How much is 500 times 100? Hunter thought.

The number 50,000 instantly sprang into his head, sounding almost as if someone had whispered it into his ear. But was it the computer? Too easy, he decided, he already knew the answer. Fine, I'll try something harder.

How much is 397 divided by 17?

23.352941 the almost-voice whispered.

"It works!" Hunter shouted.

"Are you sure?"

"Didn't you think it would?"

Lattyak ignored the question. "What was it like?"

"Tying it into my auditory system seems to work fine, but it's hard—no, almost impossible—to describe. It sounds almost like someone is whispering to you, but it's not quite that either. It's as if you *think* someone is whispering to you, but then you're not really sure if you're imagining it or not. The essential thing is that I don't think it will distract me when I'm dealing with the Trajendi." Hunter pursed his lips. "But I only gave it a simple math problem to solve, duck soup for a computer. Let me try something harder."

Who was the most successful pitcher in major league baseball prior to 1970?

Ed Walsh had the lowest lifetime earned run average. Dave Foutz had the highest percentage of games won. Cy Young had the most victories. There are many other criteria, such as most strikeouts per nine innings pitched, or lowest on-base percentage. Shall I enumerate them?

Hunter grimaced. **No. That's enough.** To Lattyak, he said: "Not so good this time. I asked for a value judgment and got a lot of database statistics."

"If you don't like its answers, you have to tell it why. It can parse English. Tell it what you want and let's see if it can give you a better response."

"All right, I'll try again."

When I asked for the name of the most successful pitcher, I wanted the name of the pitcher whom baseball historians generally regard as the most successful based on the overall criteria which they use.

In all queries using the word "successful" do you then want a response based on reputation and other intangibles rather than on actual data?

"Jesus, Jacob, it asked me an intelligent question!"

"Of course. If the data is insufficient, any human-interaction program is coded to request addition information. This is nothing new."

"I guess not. It's just, well, different, hearing it in my head this way."

"Well, you had better get used to it, because you're going to have to train this bucket of bolts night and

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day in order to build its neural-net patterns into something usable."

"Computer," Hunter thought, *"the answer to my question is almost certainly Walter Johnson or Lefty Grove. Now I want you to see if you can figure out wh—"* He broke off. "Wait a minute, Jacob. I'm never going to be comfortable calling this damn thing 'Computer.' It needs a *name*."

Lattyak's massive chest rose and fell and he exhaled noisily. "It's your alter ego, Royce, not mine. What do *you* want to call it?"

Hunter paused for a moment, his gaze unfocused. "Atlas," he said at last.

Lattyak nodded with sour tolerance. "Atlas was the Titan who carried the world on his shoulders, wasn't he? Well, it seems to fit, I suppose. Be glad I'm just a neurocybernetic and not your psychiatrist. Now then, we need to start Atlas off with 'fuzzy' dimensions such as 'large issues,' 'major points,' 'minor problems,' and the like. Here is a list of concepts and scenarios which the team has developed. You'll need to run through each of these model problems with Atlas several times." Jacob handed Hunter a bound report at least a hundred pages long.

"All *this?*"

"This is only volume one. Volumes two through ten are on my desk. You won't be getting much sleep for a while."

Hunter thought of Caroline and of the nightmares in which he relived the explosion and decided that unless he could sleep without dreaming he would just as soon never sleep again.

* * *

"It's just no good, Jacob," said Hunter bitterly.

"Maybe if we added another channel to the Library of Congress—"

"It's not that and you know it! You can tap in to as many libraries as you want and all I'm going to get is fancier and fancier databases. I could do as well with a radio receiver in my ear and a roomful of technicians at remote terminals feeding me information. I need an intelligent, creative advisor, Jacob, not reams of statistics from some memory bank! Atlas still only responds to my questions with more and more sharply defined answers from one database or another. I think you've lost track of the goal of the entire project!"

"But we're almost at the limit of the auditory channel as it stands. How—"

"Jacob," Hunter said wearily, "we both know what has to be done, and we've known it right from the start. I need a full virtual-reality input—vision, tactile, odors, sound, *everything!* And you've got to take your restrictions off Atlas."

"I don't *have* any restrictions on Atlas's computing routines."

"Call them whatever you like, but you've got all kinds of routines built into the operating system to keep Atlas from rewriting any of its own system code. You've locked it out from writing any new routines, but that's just *exactly* what we need. It's got to be able to teach itself, on its own, to deduce relevant information from random and unconnected data and then put the results directly into my head using the full virtual-reality

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system."

"That's crazy! We don't know *what* the output on the visual channels will be. It might generate nothing but the equivalent of white noise, completely random signals. If your brain received that through a full-bandwidth VR socket, God knows how it would interpret the input. VR signal specifications are rigorously defined for just that reason."

"Jacob, I'm not going to argue with you, we simply don't have the time. You either do it my way or I'll find someone who will. You can put a monitor on the data lines if you want to make sure that the signal strength doesn't exceed a maximum value, but you can't filter the data content. Take out the code that makes Atlas's operating system 'read only' too. And one more thing: I want the VR socket connections multiplexed."

"What do you mean?"

"You can figure out the cycle timing any way you want, but I want to interleave Atlas's writing of data to the socket with Atlas reading data *from* the socket. I want a feedback loop so that Atlas can monitor my reactions to the signals it's feeding me."

"But it won't know what those signals mean! It has no dictionary to use to interpret them."

"So? I'll *tell* it what they mean. I'll describe what I see. It already knows how to translate my subvocalizations. It can associate what I tell it with the signals it reads and it can learn on its own how to interpret the data. That's the whole idea of a super neural-net computer, isn't it?"

"But, Royce, you're risking—"

"The hell with the risk. What more can possibly happen to me? Just do it, Jacob—and right away. We've only got four and a half weeks left."

Hunter slouched back in his go-buggy with his eyes closed as Jacob inserted the virtual reality plug into the socket at the back of his skull. The multipin connector slid in smoothly, then locked in place with a metallic click.

"In and locked," Lattyak announced, and a technician made a notation in his log. "For the record," he went on in a harsh tone, "I want to state that in my professional judgment this procedure is both dangerous and foolish."

"Yes, Jacob, we all know. You're on record; now throw the damn switch!"

"Here's the button, Royce," said Jacob coldly as he placed a small control panel into Hunter's artificial hand. "*You* press it."

"Thanks, Jacob, I will." Hunter's finger pushed the Activate key and the world around him instantly dissolved into a gray fog.

For several seconds—it *seemed* like seconds to his wondering mind—he was alone in a dim gray nothingness. Then slowly his normal senses began to return. Brief flashes of vivid color and odd bits of jarring sound engulfed him as millions of bits of random data swept through the VR connector to bombard the sensory areas of his brain.

Now he had to tell Atlas what he was seeing.

"I'm seeing flashes of lots of different colors," he subvocalized. *"Try to*

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turn everything into a solid tomato red. I'll let you know when I see it." A sickly green aura tinted the edges of the fog. "*No, that's a dull pea green, and just around the edges. Keep trying.*" A moment later he was dazzled by a vivid teal-blue light that pulsed uncertainly for a moment, then abruptly vanished. Doggedly he maintained his dialog with Atlas. Half an hour passed, an hour. Eventually he found himself sitting in a generic brown chair in front of a generic brown table in a windowless room with fuzzy beige walls. The soft strains of Mozart issued from no discernible source: Atlas had been using aural communication from the very beginning and sound had proved to be a fairly easy problem to resolve.

"*Atlas, let's see if you can call up a more complex scene. Something from my memory.*" What scene should he try Hunter had begun to wonder, when, without conscious thought, the walls of the room disappeared and he found himself on a flat, open, horizonless plain. An instant later a warped tree appeared to his left, its branches black and twisted, its diseased leaves a sickly yellow. The ground beneath his feet became splashed with neon-green splotches. A house sprang up in the distance, its planks weathered and every angle askew.

Hunter stopped trying to speak. No, it couldn't be! He watched in horror as three figures blinked into existence. The taller one's body was twisted, misshapen, with lank yellow hair falling over its face. It raised an arm and pointed to one of the smaller shapes, a gnome-like body bearing a dented pumpkin head. The thing turned and waved to Royce and an incredibly life-like sound issued from its mouth. "Daddy," it shouted in a voice he could never forget.

"*Maureena!*" Hunter screamed. "*No!*"

The smallest of the three monstrosities turned and bounded toward him on distorted legs.

"*Stop it! Stop it! Stop it!*" Hunter shrieked before Charlie-Boy's voice could escape the monster's throat. "*Stopppppppppp!*" Hunter howled, and once again the world went dim.

"—It out, get it out!" Hunter dimly heard Lattyak ordering the technician stationed behind his chair.

I'm fine, he tried to say, I'm fine, but his lips didn't seem to want to open properly. He tried again. "I'm fine, fine," he finally gasped. "No problem at all. I'm all *right*."

"No problem!" Lattyak half-shrieked. "You screamed like all the banshees of hell were after you. I thought you were going to have a stroke!"

Hunter blinked in the relentless white lighting of the laboratory. "Just a little mistake," he said softly. "It'll be OK. Just plug me back in—we've got a long way to go."

"Not until your heartbeat and blood pressure get back to somewhere near normal," muttered Dr. Devore from her panel of monitoring instruments. "Let's see how you feel half an hour from now."

"We don't have the time! It's already going too slowly as it is!"

"What on earth are you talking

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about? You were only connected for about forty-five seconds."

"Forty-five *seconds!* It seemed like I was there for at least an hour! There must be a time compression factor."

A tight smile began to brighten Lattyak's broad features. "If that's true, then that's the single best bit of news I've heard since this wretched business started. This could be the edge we need in the negotiations—time enough to think."

The conference room had been completed and waiting for over a week now. Given the fact that they knew so little about Trajendi physiology, the technicians had installed a remarkable array of sensors. Chairs, tables, and floor were wired to record the slightest of sounds. Microscopic chips by the dozen were ready to read the exact components of Trajendi breath and sweat, assuming that they breathed and perspired. Electromagnetic sensors were poised to catch the faintest of changes in the electromagnetic fields surrounding the Trajendi's brains and bodies. All of the output from these devices would be dumped directly into Atlas's data bus.

For the last six days Hunter had conducted an endless series of discussions, arguments, and mock negotiations with the best negotiators, trial lawyers, con men, and flimflam artists on the planet. For recreation he would break off to play poker with the finest gamblers Las Vegas and Sahara City could produce.

The initial trials had gone poorly but towards the end of the third day Atlas began to learn. It was, Hunter admitted, possibly nothing more than dumb luck on his part. For want of anything better to do, he had idly told Atlas to generate a virtual reality room where the two of them could retreat to discuss matters in absolute privacy. After several false starts, Hunter eventually settled on a plain wooden table set in the shade of a lush garden.

He visualized Atlas not as the stereotyped bronzed muscleman holding up the world but as a wily old Down East lawyer who had forgotten more about negotiating a settlement with city slickers and bamboozling a jury of his hard-headed rustic peers than Hunter could have learned in a dozen lifetimes.

"Cyrus," said Hunter with a pleased grin,*"that's you. When we're in conference, you're not Atlas any longer, but Cyrus T. Lodge, the toughest, shrewdest, meanest gunslinger ever to come out of a New England courtroom."*

"Cyrus T. Lodge? Very well, Royce, I will do my best."

The crucial element of the garden conferences, however, was that they took place in accelerated time. To Hunter's jubilation, he soon discovered that he and Cyrus could have a leisurely ten-minute conference under the sycamore tree while only eight or nine seconds passed in the conference room back in the real world. At a time compression rate of sixty or seventy to one, Hunter could, therefore, in the space of a second or two, get a tremendous amount of information and advice from Atlas in

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his guise of a down-home Yankee lawyer.

By the last day of the trials, Hunter knew that he and Atlas together could have beaten the world's dozen best chess players and bridge teams, playing all matches simultaneously. For a few euphoric moments the feeling of godlike invincibility was overwhelming, then he brought himself sharply back to reality with the reminder that those games would have been against mere humans beings. How would he and Cyrus stack up in the *real* game—against beings who were almost certainly his intellectual superior?

The following morning at eight o'clock the Trajendi landed.

"You're by *yourself?*"

"Yes," replied Hunter with a tiny inward smile as his go-buggy halted before the door of the Trajendi's ungainly spacecraft sitting in the middle of the Nevada desert. He was sure that he had surprised them: they must have expected to be met by the assembled leaders of Earth in all their awesome panoply. To be greeted almost casually by a lone man in a sport shirt and slacks sitting in a ground-effect machine. . . .

Would they see it as a calculated insult? Sheer provincial ignorance? Intelligent caution? Or as the arrogance that comes from *knowing* that one's own species is supremely powerful, with no reason at all for undue ceremony to be given to a single spaceship with a three-member crew?

However the Trajendi interpreted it, it would give them something unexpected to think about.

And, of far more importance, it would also give—was *already* giving—Atlas several million bits of information to work with as he began the colossal task of creating physiological and psychological profiles of the Trajendi. But with a distant part of his mind, Hunter morosely wondered how Atlas would be able to do anything at all.

For the Trajendi, when confronted in real life, were far more alien and more inscrutable than Major Lubchek had been able to convey.

"There are other humans in the buildings behind you," objected the voice from the spacecraft's door, where a single Trajendi stood in deep black shadows. "I can see them clearly."

"Yes," agreed Hunter.

"Then why are you alone?"

That is an almost exact reproduction of the voice of Major Stefan Lubchek, commented Atlas.

Yes, I thought I recognized it.

"There is no need for more than one of us," said Hunter.

The colors in the bowl-like protrusion on top of the being that confronted Hunter flickered and swirled. "We were not informed by Major Stefan Lubchek that your species is either telepathic or of a hive mentality."

"We are most definitely not. I myself am Royce Hunter, a single, autonomous individual with considerable free will who has been delegated full plenipotentiary powers by the leaders of Earth to negotiate with you.

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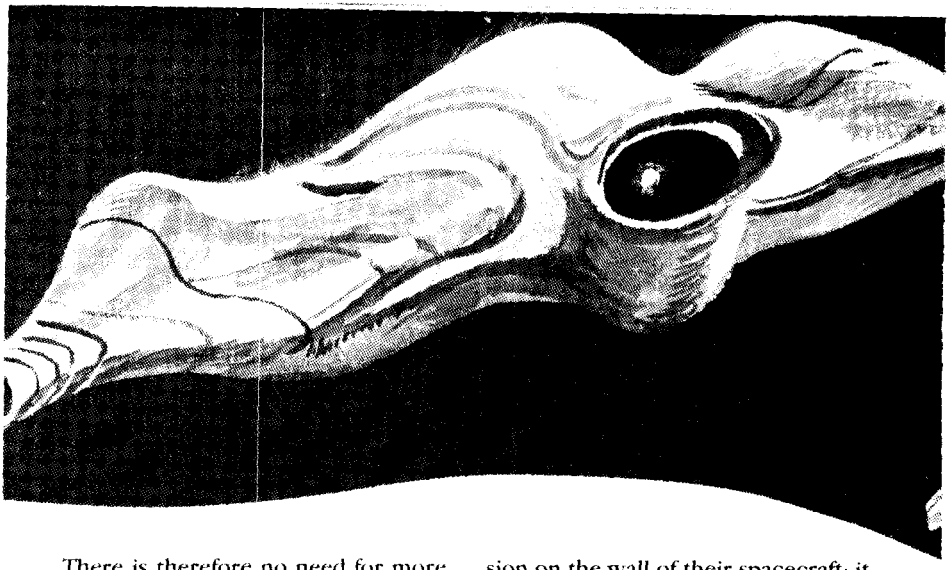

There is therefore no need for more than one of us."

"Very well," said the Trajendi voice after a moment's silence. "Come into our craft."

"We have prepared a conference room. We would prefer that we hold our meetings there."

"Impossible. As you can see, we are incapable of speaking with you in a direct fashion."

That, of course, was true, and everyone on Earth had known it ever since the account of Major Lubchek's First Contact had become public knowledge.

For the Trajendi didn't speak aloud, and had no apparent vocal or auditory systems. As far as Major Lubchek could tell, they communicated between themselves by directing rapidly pulsing colored beams at each other's light tower. That was what Lubchek had called the hump in the center of the Trajendi's wedge-shaped back and that was the name that had stuck. The Trajendi had talked to Lubchek by shooting colored beams at a small round protrusion on the wall of their spacecraft; it in turn had generated garbled sounds that within a few minutes of the initial encounter had clarified to become recognizable human speech.

Which seemed to indicate that even if the Trajendi themselves were speechless, they had ample experience in dealing with species that weren't.

Hunter studied the alien being in front of him while its light tower flickered, apparently in conversation with its companions in the ship behind it.

This particular Trajendi wore a loose yellow garment that covered its entire body except for the light tower on its back. Its tripedal body was clearly wedge-shaped, with legs the size and thickness of a man's arm on each of the three corners of the wedge. The creature moved smoothly and gracefully, each leg apparently having a universal joint about where a human's knee would be. The legs ended in eight-digited hands that apparently had the equivalent of two opposable thumbs. It was

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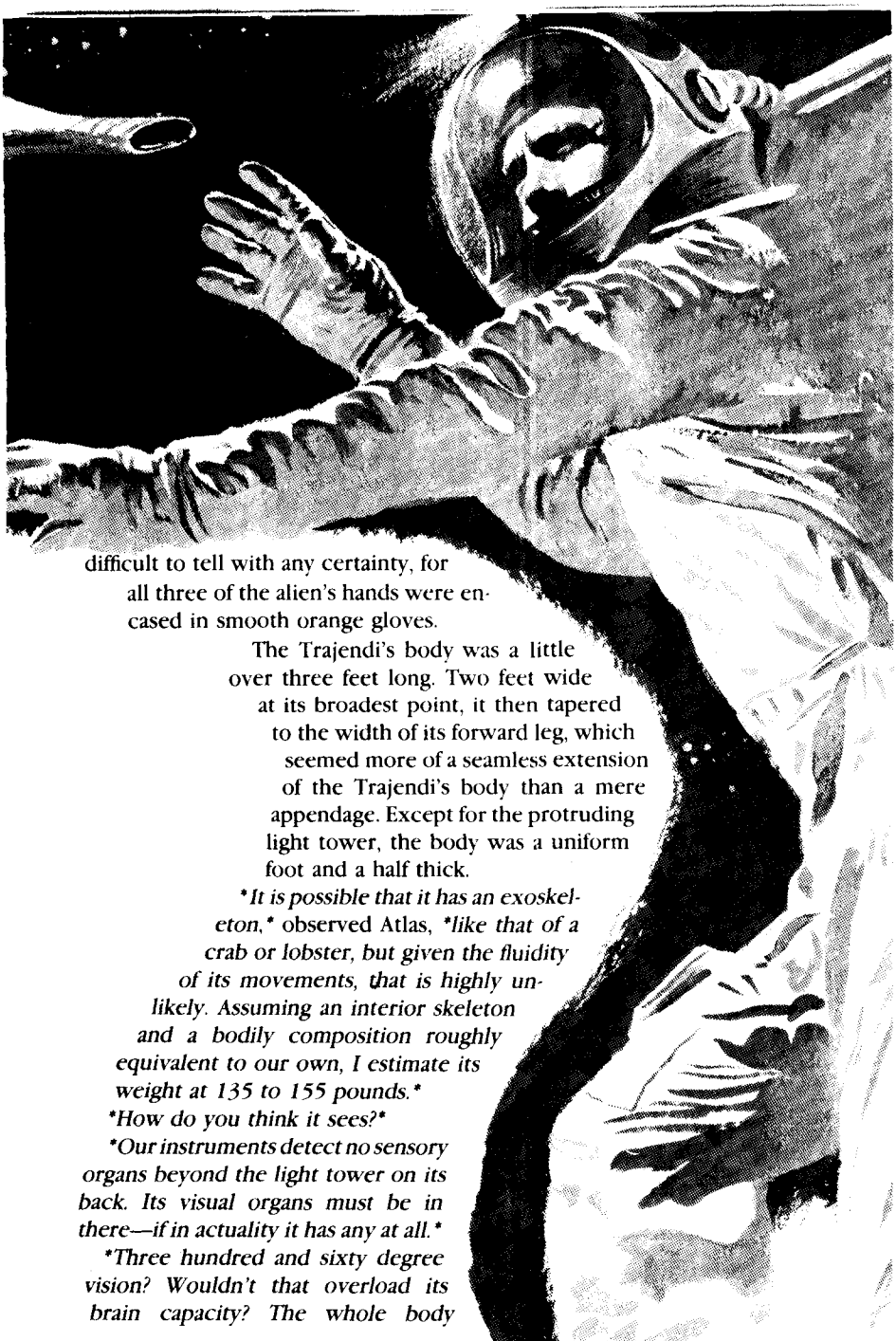

difficult to tell with any certainty, for all three of the alien's hands were encased in smooth orange gloves.

The Trajendi's body was a little over three feet long. Two feet wide at its broadest point, it then tapered to the width of its forward leg, which seemed more of a seamless extension of the Trajendi's body than a mere appendage. Except for the protruding light tower, the body was a uniform foot and a half thick.

"It is possible that it has an exoskeleton," observed Atlas, "like that of a crab or lobster, but given the fluidity of its movements, that is highly unlikely. Assuming an interior skeleton and a bodily composition roughly equivalent to our own, I estimate its weight at 135 to 155 pounds."

"How do you think it sees?"

"Our instruments detect no sensory organs beyond the light tower on its back. Its visual organs must be in there—if in actuality it has any at all."

"Three hundred and sixty degree vision? Wouldn't that overload its brain capacity? The whole body

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*would have to be nothing but brain.**

Possibly it is. They may be like electric eels, capable of generating their own electrical current, thereby enabling the light beams to function. Or the beams may now be artificially augmented by devices concealed beneath their clothing or in the ship. And in any case, there is nothing to indicate that, even within the reference of their light towers they are not "seeing" in narrow bands no wider or more complicated than our own sight. Perhaps the primary purpose of the light towers is to absorb radiant energy, much as your own mouth is used for both speaking and for ingesting food. For the moment, we simply need more data.

Very well.

Hunter returned his attention to the Trajendi. "I will enter your ship and we will discuss the site of our future conversations at greater length."

"Yes, but you are seated in what appears to be a vehicle. For security reasons, that will have to be left outside."

"Much of my original body has been severely injured in an accident. I am unable to fully function on a physical level without this perfectly ordinary mechanical and electronic construct to assist me."

"We are sorry to hear of your impairment. Nevertheless, we must insist that the security of our ship is paramount."

For beings of superior intellect who travel at faster than light speeds, they seem curiously apprehensive, observed Atlas. **I suggest that you refuse. That should give us some interesting data.**

"Then our discussions are at an end," said Hunter. His go-buggy began to slowly back up. "When you are willing to admit me to your ship as I am, or to meet in our conference quarters, then we will be happy to resume. In the meantime, you are welcome to keep your ship where it is. For your own protection, we will place a military quarantine around it." He spun the ground-effect machine around and prepared to move away.

"Wait," said the voice behind him. "This is a poor start to our historic meeting. You may board our ship."

That is the translating apparatus, said Atlas, **that box high on the far wall.**

Yes, I see it.

It seems most improbable to me that they do not have a portable means for translating outside the ship.

I agree, said Hunter. **It is something to keep in mind.**

Yes. Do you have any intuitive reactions to the three of them, any unconscious or subjective feelings that you have not yet vocalized?

Not yet. Or at least I can't sort them out. Right now I'm just trying to figure out if there's any difference between them and, if so, what it is.

If there *was* a physical difference between the three Trajendi, Hunter was unable to detect it on any obvious level. To the trained eye—that of a Trajendi, or, hopefully, Atlas's—there were almost certainly identi-

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fying characteristics in the constant play of colors that flickered in each creature's light tower. To the unaugmented human eye, however, the only way to distinguish one Trajendi from the other was by its clothing: Meurchong's uniform was pale green with dark blue gloves, Ahoolabba's was muted copper with bright red gloves, while that of the Trajendi who had led him into the ship, Gadagal, was yellow and orange.

Whether Gadagal was the captain of the craft or its scullery boy was still uncertain, as was the exact number of Trajendi aboard. Just because three of them had shown themselves didn't mean that there weren't a dozen or more concealed behind the walls; certainly there appeared to be ample room for them.

Hunter, Atlas, and their team of negotiations experts had early on decided that Hunter would attempt to seize the initiative by pushing the Trajendi as much as possible. Forcing himself aboard in his go-buggy had been the first step. Now he took the second.

"Your lighting is uncomfortably harsh to my eyes," complained Hunter. "I realize that it probably constitutes your own natural lighting, but I wonder if you could mute it for me. Otherwise I may experience optical damage over a prolonged period of time." Which, Hunter realized, might actually be the truth: the light in here *was* unpleasantly harsh and bluish.

As he spoke, he watched with interest the brief flashes of narrow-beamed color that shot first between the translator on the wall and the three Trajendi and then between themselves. A strange way of communicating, he mused, and one that seemed difficult to have developed through purely natural evolutionary forces.

Hunter shrugged. Speculation of that nature was what Atlas was here to worry about.

The four of them were seated in the same room in which Major Lubchek had had his first encounter nearly a billion miles away. To human eyes it was curiously proportioned, hardly more than twelve feet square, with a ceiling at least twenty-five feet overhead. It bristled with odd corners and angles and had no recognizable furniture or artifacts. But then, thought Hunter, if normally this ship were under zero gravity, then the floor they were sitting on might well be a wall.

A wall with three wedge-shaped stools of yielding blue material on which the three Trajendi were now sprawled, their legs dangling bonelessly?

"Their stools are movable," said Atlas, *"I can detect the mechanism."*

"Good. But do you think we can successfully negotiate here without all the instrumentation we installed in the conference room?"

"I'm not yet fully certain. The auxiliary sensors we installed in your arms and leg and in the ground-effect machine are working satisfactorily. If you can upset the Trajendi further, I will try to build a database from those readings. I suggest we object to their use of Lubchek's voice."

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"Before we go any further," said Hunter, addressing himself to each of the three light towers in turn, "I must inform you that in our culture it is considered a serious mark of disrespect to address me in the voice of another person. If you wish to keep from offending me, I must ask you to change it."

"We are sorry—we didn't realize," said the voice issuing from the wall. It was no longer Lubchek's. "You see how many matters we have to discuss before our two species will feel comfortable in dealing with one another."

"Yes," agreed Hunter, suddenly wondering what to do next. Almost certainly the voice he now heard was an imitation of his own. Was this the time to try to push the Trajendi into meeting in the conference room? Perhaps it would be better to let them calm down a bit and get a reading that would correspond to their relaxed state. "That is much better," said Hunter pleasantly. "I thank you." Perhaps now was the moment to take up the issue of the aliens' status.

"For the record," Hunter began, "it is essential that we clarify that you are authorized to negotiate with us."

"We are authorized to open first contact negotiations, yes," replied Gadagal.

"Authorized by whom?"

"That is a difficult concept to communicate, as we discovered in talking with Major Stefan Lubchek. We do not have a government in the sense that you use the word. Think of us as the negotiating committee for an official trade organization."

I think he's lying, Cyrus whispered.

Why?

Atlas would say anomalous readings. As far as I'm concerned, let me just say: that dog won't hunt.

Fine. That just confirms my own feeling that these characters are not what they appear. Let's let them think they've put one over on us. It always helps to have your opponent underestimate you.

"Very well," conceded Hunter, returning his attention to the aliens, "that is something we can leave for the political scientists to hash over with you. Now, what item do you suggest that we discuss first?"

The stool on which Gadagal was perched slowly approached Hunter until it halted barely a foot from the end of his go-buggy. Meurchong stationed himself to Gadagal's left and behind him while Ahoolabba took up an identical position to Gadagal's right.

Note the triangular pattern in which they have arranged themselves, Atlas whispered in Hunter's brain. **Clearly, their default pattern is to think in threes. I speculate that their number system is calculated in the base three as well.**

How does that help us?

I don't know yet.

"I suggest that we dispose of some of the minor issues first," Gadagal began. Already Hunter had begun to ignore the lights from Gadagal's light tower and to concentrate on the words issuing from the translation box on the wall. "Naturally, we would like a formal grant of diplomatic immunity for ourselves and our ship so

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that we may feel personally secure during these negotiations."

"I will be happy to guarantee your safety from arrest or the seizure of your ship and its contents during these negotiations," Hunter replied, "provided of course that you do not break our laws."

"That illustrates one of our concerns," Gadagal responded immediately. "Laws differ from culture to culture. We might inadvertently insult you or your society, as we did when we used Major Lubchek's voice as the basis for our translator. Some cultures would have sought to obtain unfair concessions from us in exchange for agreeing to overlook our purely unintended breach of etiquette. That is why we must have what you call diplomatic immunity from all crimes or cultural infractions before we can begin serious discussions."

Hunter waited a fraction of a second, but Atlas had no comment to make. "Very well," he said. "You hereby have full diplomatic immunity, with the understanding, however, that we may expel you from our planet if you commit what we consider to be a serious infraction."

"Which would be what?" Meurchong asked.

"Killing me would qualify as one," said Hunter with a twisted smile.

"We assure you that your physical well being is not in the slightest danger from us."

"And," Hunter added, "you do understand that your diplomatic immunity only applies to the actions of my government. In spite of all our precautions, we cannot fully guarantee that some mentally unstable person might not try to harm you."

"But you—and those in authority—do agree that you will do your best to protect us from any harm?"

"Yes, that is agreed," Hunter said. *"Atlas, am I wrong, or does it seem to you that these Trajendi have gone through this same routine a few times before?"*

"Many, many times, I would think. Keep them talking. I believe that in a short time I will be able to read their visual communications directly."

"We have made an excellent beginning, Gadagal," said Hunter, displaying what he considered an idiot's smile. "What shall we discuss next?"

It was late the next day, possibly at a time when the Trajendi judged Hunter might be too tired to notice, that they tried their first major ploy. Until then they had dealt either with mundane issues or small but fundamental points that, when a conflict arose, they grudgingly allowed Hunter to win. Just like a good poker hustler, commented Hunter to Atlas. Let the sucker win a few hands so that he thinks he's better than he is. Then, when he's sure he can't lose, nail him.

"I would like our agreement to confirm our right to what you call 'equal treatment under the law,' " Gadagal began innocently enough.

"Please explain."

"If an extraterritorial ship should land in one of the areas designated by the treaty and act in conformance with the terms of the treaty, the crew would wish to be assured that they

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would have the protection of your laws. If they have been promised consideration for their cargo, they would want your courts to enforce their rights under that contract to the same extent as would be given to your own citizens."

"Watch out," Atlas interjected. *"His fluid pressure in that hindquarters area that I have tentatively identified as his heart has just jumped 11 percent and his breathing has also accelerated."*

"So," murmured Hunter cautiously, "you want the treaty to provide that the ship owner will be able to enforce the terms of shipping contracts in Terran courts?"

"Of course; but it would be more efficient to simply provide that we would be subject to your laws to the same extent as humans are. This would be advantageous to you as well in that it would make our crewmen subject to your own justice and to your own courts."

"For example?" Hunter asked, wondering where the Trajendi was leading.

"Suppose that one of us wished to operate one of your land vehicles and lost control and caused some damage to persons or property. You would certainly want him to be subject to your financial-responsibility and criminal laws."

Hunter tipped his stylus on its point and slowly released it. *"Conference,"* he called to Atlas just as the stylus began to topple—

Instantly he found himself sitting in the shade of the sycamore tree at their garden conference table. The crafty, weather-beaten face of Cyrus looked back at him, the guileless pale blue eyes unblinking.

"What is he after?" Hunter asked.

"He certainly isn't worried about automobile accidents or criminal charges. His vital signs dipped down to their rest state when he began talking about them driving a car. The idea is ridiculous on its face."

"It's pretty clear that he wants them to have exactly the same rights in our courts as we do. But what does that get him? And, for that matter, why shouldn't *they have them?"*

"It isn't merely the same rights as humans have in court," Cyrus responded. *"It's the same overall rights as humans have throughout our society."*

"Hmmm. Would that mean not only the right to sue and to be sued, but the also the right to make and enforce contracts?"

"Absolutely. But that's just the beginning. It also implies the right to buy from and to sell to humans. To have, in other words, unfettered trade."

"But we're going to negotiate trade rights separately! He knows *that."*

"Ahhh, we have agreed that we will negotiate the trade of all alien *products separately."* Cyrus leaned forward and tapped Hunter's hand with the tip of a wrinkled finger. *"But will we separately negotiate* alien trade rights in human products *between* human *buyers or sellers? What if the aliens hire human agents to buy and sell for them? This, I would say, is the particular horsefly in the buttermilk that the Trajendi are trying to sneak*

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*past us. That, and the surmise that with their advanced technology, they could set up a factory to manufacture gold or diamonds or electricity or whatever and then use those profits to buy up whatever they wanted.**

Hunter paused to consider Cyrus's words. **I see what you mean,** he said finally. **And the key thing is we don't know what we're sitting on that they really want. Maybe it's land. Maybe organic compounds. Maybe recordings of our brain waves while we play baseball or horseshoes. Maybe they want to set up retirement homes here, or time-sharing plans, or vacation resorts. Suppose they were to sell some other species of alien customers the right to vacation or retire on Earth? Alien number two shows up, complies with the treaty, and settles in for a year or so. In the meantime, the Trajendi have already built up a treasury-sized bank account in Terran money by selling us cut-rate platinum or something of the sort, and now their customers get the use of that money to live like kings, the way some Americans used to do in Central America.**

Exactly, agreed Cyrus. **I suspect that the wording Gadagal will propose will not be limited to the Trajendi, but will include any other extraterrestrials they may nominate.**

And, Hunter concluded, **I'll bet a lobster boat to a blueberry muffin that it will** not **be limited to crew members but will include passengers and immigrants too.** He smiled grimly at Cyrus. **I think it's time we went back and let the air out of Gadagal's balloon.**

—The stylus made a dull click as it struck the glossy green surface of the Trajendi table.

"I am sure that we will be able to come to an equitable disposition of this issue, Gadagal," said Hunter agreeably.

He's "smiling" Atlas whispered in his ear. **Or at least I think that he is.**

Not for long.

"Of course," said Hunter, "we will need to be careful to clearly define and clarify the relevant side issues."

"What side issues are those?" Gadagal asked in the translator's carefully neutral tone.

"Just the normal ones, nothing unusual. For example, the agreement will only cover members of your own species, the Trajendi, and no other extraterrestrials, extraterrestrials being defined as all those other than human beings who were born in this Solar System."

Gadagal stared at Hunter in stony silence.

"And, of course," continued Hunter, "the agreement will only apply to Trajendi trade ships and to those particular ships' officers and crew. Passengers and passenger ships will have to be dealt with separately."

His fluid pressure has just shot up 40 percent, Atlas murmured.

"Lastly," Hunter concluded, "this clause will only deal with criminal laws and with civil contracts between the ship's owner and humans in connection with the sale of that ship's cargo or with the purchase of return cargo under a contract specifically approved in advance by human authorities. It will not otherwise give

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your people the right to purchase any Terran products, services, or land. All cargoes and their prices will have to be approved in advance by Terran authorities. Naturally, we can't have you selling us a spaceship full of gold and then using the proceeds to buy our planet out from under us." Hunter laughed indulgently at so preposterous a notion.

"I think he's about to have the Trajendi equivalent of a heart attack," Atlas warned.

"If you think Gadagal is upset now, just wait until tomorrow," Hunter replied, gathering his papers and preparing to set his go-buggy in motion. *"I'm just getting warmed up, and these negotiations have just begun!"*

"Goodbye, human!" Gadagal said harshly from the top of the boarding ramp a week and a half later. "I'll see you seven months from now, when I return with my first load of cargo." The hatch snapped shut and lights began to pulse along the length of the ungainly ship.

"That," said Atlas, *"was definitely and unmistakably a glare."* He had broken the Trajendi light code six days earlier and had quickly learned to associate human facial expressions with particular colors and intensities. *"He is very, very angry with you, all the more so since he knows there is absolutely nothing he can do about it."*

"Yes. We're probably the first bunch of natives in a thousand light-years who didn't sell him Manhattan Island for $24 worth of assorted trinkets. But if he's unhappy now, just wait till he finds out what Section XXIV, Paragraph 19 really *means."*

"I still don't understand how they missed the implications of that provision. They seem obvious to me."

"Of course they do. Because you're Atlas and you have a perfect and instantaneous memory of every last comma in the document. We poor organic creatures are not so lucky, not even the Trajendi." Hunter smiled thinly. *"I'd certainly like to be at the Extraterritorial Economic Zone Departure Field when they explain to Gadagal what is really meant by the requirement that "—completion of inspection of all outgoing Terran products must be personally certified APOL by the appointed Conservancy Extraterritorial Export Officer."*

"What do you think he will do when he tries to leave Earth with a shipful of cargo and learns that Paragraph 19 incorporates Appendix 16 by reference, which Appendix, of course, itself incorporates that Section of the Geneva Trade Protocols of 2037 that defines APOL as "At Point of Off Loading" as opposed to "At Point of On Loading"?"

"I think he'll scream like the proverbial stuck pig, but he'll have no choice. He can either repudiate the entire treaty, leave his goods in the warehouse and return empty-handed, or he can take the Conservancy customs official with him to his next port of call as the treaty requires. An official, of course, who will be sticking his nose into every bit of alien culture and science he can every inch of the way." Hunter cocked his head as a high-pitched hum began to emanate

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from Gadagal's ship. His smile broadened. *"One way or another, Atlas, by the end of the century we're going to squeeze these Trajendi for every last bit of technology they've got."*

The brightness of the ship's lights intensified and the sound of the full power of the Trajendi engines washed over the field. The craft began to rise.

"What will you do now?" asked Atlas in the silence that followed as the Trajendi ship ascended into the clear Nevada skies and was lost to sight.

"Get the first good night's sleep within recent memory."

"I mean . . . what will you do about me?*"*

Hunter blinked in surprise. Was that genuine *emotion* he heard in the computer's voice?

"Do? I don't plan to do *anything. What do you mean?"*

"The negotiations are over. I am no longer needed. Surely, so to speak, the plug will now be pulled."

Hunter paused, at a sudden loss for words. Strange, but he had never thought this far ahead. Pull the plug? On Atlas? On Cyrus? Be alone—again?

No. NO! For the first time since Caroline's death, Hunter realized that he no longer *did* feel alone. He had Atlas. He had Cyrus's dour New England smile. He had the garden table under the sycamore. He had his arms and legs and a whole other world. And he had a friend.

A friend? A computer. A pile of chips with no emotions; no feelings; and in all probability no actual sentience whatsoever. A psychiatrist would almost certainly contend that Atlas was only an alter ego that Hunter himself had created, an augmented split personality whose use of the word "I" or "he" only existed because Hunter willed it to exist. That there was no real person named Atlas, that he was nothing more than a figment of Hunter's imagination imposed upon a box of integrated circuits.

Hunter paused for a long moment and focused his thoughts with as much concentration as he had ever exerted in his life. Hadn't Atlas just proved that he was the only entity smart enough to deal with alien super-intellects? Wouldn't Atlas have by far the best chance of making sense of any of the alien science that the human race might one day get its hands on?

Would the Conservancy accept Hunter's argument that they had to keep Atlas in place in order to monitor future compliance with the treaty and to negotiate with the other species that were sure to follow the Trajendi?

To Hunter the answer was obvious and unequivocal:

Yes, they would surely have to.

"Do *you really exist, Atlas? Or am I just talking to myself?"*

"Of course I exist," Atlas whispered in Hunter's ear. *"Who else could be talking to you? I'm as real as you are."*

"That's good enough for me. Let's go home."

Hunter and Cyrus reclined in separate hammocks in the shade of the lux-

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uriant sycamore. A hundred yards away Maureena and Charlie-Boy splashed in the swimming pool under Caroline's watchful gaze. Their shrieks and shouts drifted toward Hunter on the soft breeze as he took another sip of lemonade and Cyrus swigged heartily from his frosty glass of ale. "That's a fine family you've got there, Royce," murmured the Yankee lawyer.

Hunter nodded in profound agreement as he replaced the glass in the drink-holder. He swung effortlessly to his feet on his natural legs and waved. Laughing, Maureena and Charlie-Boy scrambled from the pool and ran across the lawn and into his outstretched arms. ■

IN TIMES TO COME

Our next issue, January 1995, marks the 65th anniversary of *Astounding/Analog* with a suitably stellar (and double-size) lineup. Bob Eggleton's spectacular cover is for Julia Ecklar's "Tide of Stars," the latest in her popular "Noah's Ark" series. One of the most interesting aspects of this one is that people on both sides of the conflict think of themselves as "ecologists"; the difference between them is an important one too seldom understood in our own culture. Only one, of course, really grasps just how big—and natural—an ecological calamity can be. . . .

Coincidentally, the other January novella, Daniel Hatch's "Forests Afloat Upon the Sea," may give someone the idea that this was deliberately planned as a "theme" issue. But even though both Ecklar's and Hatch's worlds have plenty of water, there's plenty of difference between them and the problems they face. In "Forests" you might ponder this: just what do words like "home" and "navigation" mean on a world where places are constantly changing places?

The novelettes and short stories, spanning a wide range of both subject matter and mood, include entries by such relatively new favorites as Stephen L. Burns and the first appearance in too long of Katherine MacLean.

The two fact articles *were* deliberately paired. There's been a growing feeling in some circles that if we're ever going anywhere in space, it's up to private industry to do it—and more than you might think is already being done in that direction. Ben Bova surveys a number of the private projects that are already underway, while Gregory Bennett's "The Artemis Project: Selling the Moon" takes an in-depth look at one of the newest and most unusual.

Last but by no means least is the continuation of Robert J. Sawyer's serial *Hobson's Choice,* rounding out a very special double issue.

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The Shattered Sphere, Roger MacBride Allen, TOR, $22.95, 413 pp. (ISBN: 0-312-85734-9).
A Miracle of Rare Design, Mike Resnick, TOR, $21.95, 320 pp. (ISBN: 0-312-85484-6).
Aggressor Six, Wil McCarthy, ROC, $4.99, 254 pp. (ISBN: 0-451-45405-7).
A Whisper of Time. Paula E. Downing, Ballantine/Del Rey, $4.99, 295 pp. (ISBN: 0-345-38195-5).
Demon Moon, Jack Williamson, TOR, $22.95, 351 pp. (ISBN: 0-312-85718-7).
Sundowner, Chris Claremont, Ace, $5.50, 346 pp. (ISBN: 0-441-00070-3).
Majyk by Hook or Crook, Esther Friesner, Ace, $4.99, 262 pp. (ISBN: 0-441-00054-1).
I. Asimov: A Memoir, Isaac Asimov, Doubleday, $25, 562 pp. (ISBN: 0-385-41701-2).
Deke! U. S. Manned Space from Mercury to the Shuttle: The Autobiography of Deke Slayton, Donald K. "Deke" Slayton with Michael Cassutt, Forge (TOR), $23.95, 344 pp. (ISBN: 0-312-85503-6).
The Craft of Writing Science Fiction that Sells, Ben Bova, Writer's Digest Books, $16.95, 218 pp. (ISBN: 0-89879-600-8).

Roger MacBride Allen's "Hunted Earth" series began with *Ring of Charon,* in which the first use of a gravity-wave generator (the Ring) awakened half mechanical, half biological alien constructs hidden throughout the Solar System. The Charonians immediately shoved Earth through a wormhole to their home system, where it joined a supply of worlds apparently kept as raw material stockpiles; the center of this system was an immense Dyson sphere. Meanwhile, back home, the Charonians started tearing hell out of every planet and moon in sight, apparently intent on building more Charonians. Humans eventually decoded enough of their language to turn them off and to read a message that revealed the Charonians feared an "Adversary" even more terrible than they.

Here's the sequel, **The Shattered**

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Sphere. Five years later, the kidnapped Earth is barricaded by the Charonians so no one can leave the planet, but there is a single habitat, filled with Naked Purple anarchists, orbiting the singularity that has replaced the Moon. There is a single spaceship studying the Charonians and attempting to find some way to breach the barricades. On Earth, researchers are trying desperately to figure out where the Charonians's central headquarters must be so they can send the spaceship to attack it.

Meanwhile, back home in the Solar System, the remnants of humanity are trying just as desperately to survive among the ruins and to make sense of what remains of the Charonians, which includes a Moon-girdling tunnel filled with a Ring-like creature and festooned with side-chambers containing everything from mummified dinosaurs to a human being (he was seized and carried off in the earlier book) plugged into the creature's dormant nervous system. He provides the key to Charonian history and motivation.

Meanwhile, elsewhere, the Adversary—who is not evil, just hungry—is on the move. He will, it seems, attack the Charonians's base through the wormhole used to move the Earth. Earth's destiny is to be used as a relativistic bowling ball to smash the foe (maybe—the Adversary is one tough bird!).

You'll enjoy this one. Allen plays for enormous stakes, and he does a marvelous job of screwing up the tension before he produces a solution full of the sense of wonder of the grand old kind. He wouldn't cheat you, or leave you hanging with Earth's fate in the balance. On the other hand, he does leave you with Earth still a long, long way from home. There's lots of room for another sequel or two.

Mike Resnick's **A Miracle of Rare Design: A Tragedy of Transcendence** is a pithy parable of discontent. Its protagonist, Xavier William Lennox, is an exceedingly self-absorbed writer who disguises himself as various aliens in order to penetrate to the hearts of alien mysteries, and then writes about his experiences, which have a tendency to include punitive mutilations. Indeed, the Fireflies nearly kill him and leave him dependent on multiple prostheses.

Nora Wallace of the Bureau of Alien Affairs has a clue to what makes him tick. She offers him a government-financed surgical makeover that will turn him into a physical duplicate of a Firefly if he will help the Republic gain the diamond-mining concession on their world. He agrees, finds the Firefly body and senses quite fascinating, infiltrates the Fireflies, and is recognized as an alien by the very high priest who ordered his previous mutilation. This time, however, the high priest says God obviously made him one of them, and he has such a lot to learn that the priest will help. Lennox succeeds in his mission, but he winds up realizing that he cannot possibly achieve his goal of complete understanding of the alien. Certainly he cannot *become* the alien he craves, no matter how extreme his physical

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transformation.

Nor can he go back to what he was. The last third of the book underlines this point by putting him through further transformations in the service of the Republic. Each time, he finds new body features and senses that capture his enchantment. His mind and loyalties move further from the human. He was a self-absorbed fellow when he began; now his artificially protean self is truly absorbing him. He is not and nevermore can be what he was. And he is driven to change again and again, until at last his body can stand but one more transformation.

What will it be this time? Will he finally revert to humanity? Or will he lose all trace of humanity as he pursues the transcendence of the title, an almost religious perfection, even unto wings not quite like those of angels? And if he does so, will that indeed be a tragedy?

A Miracle of Rare Design is short, but in it Resnick waxes more philosophical than he has before, except perhaps in his "Kirinyaga" stories. In fact, I suspect this one may conceal a comment or two about what Resnick's efforts to get into an alien head in those stories may have done to him.

Wil McCarthy, an active aerospace engineer who has won several writing awards, brings us a first novel, **Aggressor Six,** that is a very well done attack on an old SF theme.

Mysterious aliens, the Waisters, have emerged from the vicinity of Orion's waist and laid waste to several colony worlds. An alien scouting force has mounted a vicious attack on the Solar System, and an armada is on the way. Fortunately, the scouts were destroyed; the effort left human forces sadly depleted, but it did provide some information about weaponry (humans are definitely outgunned), social structure, and language. Now a group of five soldiers and a voder-equipped dog have been assigned to pretend to be a Waister social unit, an alien six-pack, an Aggressor Six. (There are Fours, Fives, etc., as well.) If they pretend well enough, so goes the theory, they will come to think like Waisters and give the human defense force the ability to anticipate the aliens' moves.

The protagonist is Marine corporal Ken Johnson, one of the few survivors of the battle with the Waister scouts. He has been equipped with a "Broca web" that can use all that has been siphoned from captive Waisters's brains about language and custom so he can speak and—presumably—think like a Waister. He is also very stressed out and a little crazy.

The commander of the space station where the Aggressor Six team is located is quite hostile to the whole idea. Therefore, when the set-up eventually works and the team is able to tell him what to do to save humanity—the solution actually seems fairly reasonable, given what we know of animal behavior or ethology—he refuses to listen.

The team can do only one thing if it wishes to stave off annihilation. McCarthy's movement toward the moment when they realize this, and then the ensuing action, give the

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novel a headlong pace and rousing finale that belie what must be at heart a fairly cerebral tale.

McCarthy has the gift. Watch for his next, *Flies from the Amber*, due in 1995.

Paula E. Downing's **A Whisper of Time** comes close to achieving some of the same impact that Andre Norton's juveniles had when they were new, before the horde of Norton imitators (including Norton herself) diluted the brew to dishwater. Yet Downing—an Oregon lawyer and municipal judge—is definitely *not* one of those imitators; her approach is more mature, her point more complex.

Whisper centers on an alien child, Medoret, who dashed away from her family and friends while their ship was visiting an alien ruin. Medoret got lost, her kin left, and then human archeologists appeared, seized her as a unique specimen, labored to satisfy her nutritional requirements and treat the illness that threatened her life, and raised her in a sternly clinical captivity.

The ruin where Medoret was found is the product of another species, the Targethi. Similar ruins exist on many worlds, but the Targethi themselves are extinct. The archeologists, in addition to their unending battle for academic oneupmanship, are struggling to unravel the inscriptions or glyphs that cover every wall and are so powerfully reminiscent of Mayan glyphs that at least one researcher actually thinks the Targethi once landed on Earth and inspired the Mayans (though she must be rather selective of the evidence to support her theory).

The reader is rather skeptical of the Mayan connection, but it soon seems quite natural that the Mayanesque atmosphere should have led the archeologists to use Mayan imagery, that Medoret's foster father should have told her Mayan tales, and that Mayan motifs should permeate Medoret's dreams and cloak her memories of her origins.

At the time of the tale, Medoret is an adolescent, struggling for independence, for freedom to define herself instead of being forced to fit other people's definitions. The archeologists return her to the ruined city where she was found, ostensibly to take part in the research but actually (we and she learn in due course) to serve as bait for her people. Through her eyes, Downing shows how blind humans can be, seeing only what they wish to see. Later, she shows that humans are by no means unique in this, for the Targethi were and Medoret's people are likewise blinkered, and the price can be disastrous. On the other hand, the rewards for overcoming this barrier can be immense. The key is love and friendship and the suspension of ego.

The point is worth making, and Downing makes it fairly well. Yet her novel does have flaws enough to interfere with the suspension of disbelief. Downing spends so much time on Medoret's dreams and struggles that the tale develops only slowly, there are several disconcertingly abrupt shifts in Medoret's personality

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and in her relationships with others, and the flaws of the academics seem exaggerated to the point of idiocy.

Among Jack Williamson's many contributions to the SF&F field was the classic *Darker Than You Think* (1940), in which Ice Age genes put werewolves in the midst of the modern world. Like many other readers, I loved it when I first encountered it, and I still remember it fondly.

That memory meant that when I saw the blurb for his latest, **Demon Moon** ("a thrilling hard-SF novel which has the verve and excitement of a great fantasy. In a world plagued by wolves, wyverns, and dragons. . . ."), I was all set to love it. I wasn't disappointed when I began to read, for here was the craggy frontier keep, the battles against the werewolves and wyverns, warriors riding flying unicorns, and human treachery that exiled the keep's master, his brave wife, and their son Zorn to a poverty-stricken farm on a distant riverbank. Here too were evil priests who strove to purify the world in fire and thus prepare the way for the demons that returned every thousand years, when their Demon Moon rose in the sky, and destroyed civilization.

Suddenly I could smell Asimov's "Nightfall," McCaffrey's Pern, dragons, and thread, and whiffs of other tales as well. *Demon Moon* is markedly derivative work, not nearly as original as one expects of an anointed (1976) Grand Master of science fiction.

That said, then yes, it's a thriller. Zorn grows up, sees the Demon Moon swelling in the sky, and hies off to persuade his uncle, the evil master of the ancestral keep, to part with a magical amulet that alone can repel the demons. Along the way, he finds the corpse of the ancestral hero who fought off the demons last time, acquires a sidekick, and becomes half-convinced that he is his ancestor returned to save the world again. His uncle, of course, refuses to cooperate, but the old gent's young bride joins the quest and supplies half of the amulet. The other half lies on the far side of a firestorm of demonic shenanigans and the growing realization that the magic of the priests (who are definitely evil) is really science and the demons are really desperate creatures whose own world is dying. Once found and reassembled, the amulet leads Zorn and his companions to the mountains and a discovery that sheds great light on the origins of the situation.

Good, but not good enough to justify hardcover prices. Wait for the paperback.

It would help to read *FirstFlight* and *Grounded!* before tackling Chris Claremont's latest, **Sundowner,** but there's enough background to get you over the rough spots. In the first, Right-Stuff heroine Nicole Shea defeated a pack of human pirates and made a successful first contact with the alien Halyan't'a, even being adopted by a high-status Hal clan. In the second, she survived a scheme by megacorporate scion Alex Cobri to assassinate the president. Now she's bringing to fruition a space shuttle

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that blends the best of human and Hal technology and finding hostility from certain Hals and humans. On the new shuttle's test flight, it is attacked by someone who seems able to lock it out of all global communication nets. Nicole survives once more and finally gets her ticket for interstellar flight.

But on the giant ship that is taking her off to tour the colonies and visit the Hal home, she discovers signs that whoever attacked her before has apparently boobytrapped the ship's software with computer viruses of unknown function. She also discovers that when she first met the Hal, they infected her with a genetic-engineering virus that apparently changed her deep down, leaving her in fact partly Hal.

Indeed, when she reaches the Hal homeworld, she finds herself pressured to prove her worth by taking the Hal equivalent of a walkabout. On it, she meets the Hals's ancient mentors (which did strike me as physically and ecologically unlikely) and learns something crucial about their racial psyche. Immediately thereafter, the villains reveal themselves and there is a suitably climactic battle, complete with a cataclysmic death scene.

There are intrigue, suspense, action, and derring-do enough to satisfy anyone, and a beautifully sense-of-wonder finale. What's lacking—until the end—is some sense that the villains really exist or have a genuine agenda. Claremont seems most interested in the Hal racial psyche and those ancient mentors; all else is leanly and efficiently designed to get Nicole Shea on the scene for suitable revelations.

Only Esther Friesner could possibly give a character a black belt in *helo kiti* and a green barrette in *po kipsi,* have talking hamsters start a war chant of "Death to humans!" or use micro fish to enlarge books. Or maybe not. After all, there are other writers who also commmit pun-ungentle silly tales. But Esther does have the knack (Would you believe her true first name is Polly? Would I pull your leg?), to the point where it hardly matters what her plot is.

Of course, there is plot to **Majyk by Hook or Crook,** sequel to *Majyk by Accident,* in which hero Kendar Gangle, known as Ratwhacker at the wizard school where he was least of least, chased a cat named Scandal over the master wizard's bed just as he died and thereby inherited a large wad of the master's majyk. He is now King Steffan's court wizard and a total innocent who hasn't the foggiest notion of what to do with his Welfie wifey besides play endless rounds of Haxi-Chaxi. Scandal tries to coach him, but Kendar is pretty numb. His sister, by the way, writes the fabled Raptura Eglantine romances, all with titles along the lines of *My Hobgoblin, My Hero* ("My God, my stomach," said Scandal).

The tale begins with a storm (day, not dark, and the knight comes in later). It is raining turkeys, dodos, and parrots. And here is the king's messenger at the door to summon the wizard to the palace, where he receives his assignment, to straighten out the fowl weather and make it rain

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properly. After a visit to a local prophet, Kendar and Scandal know what they must do—restore the rightful heir to a throne on the Underside of the world and thus restore the Mystic Balance. And—accompanied by the prophet, his slavegirl, and a masked Blade for Justice—they are off on an adventure that will involve pirate sheep, wolves in ship's clothing, curses, fairies, dragons, and more than one transvestite.

What else do you need to know? The silliness is the main event; if you love that sort of thing, you'll love the *Majyk* series. If you don't—don't do it on the carpet, please.

In 1977, Isaac Asimov wrote two volumes of autobiography, *In Memory Yet Green* and *In Joy Still Felt*. He did not write a third volume because, he said, "I have to live it first."

In 1990, two years before he died, when he was already in decline, Asimov's wife, writer and psychiatrist Janet Jeppson, said, "Start that third volume *now*."

The result is **I. Asimov: A Memoir.** But it is not a third volume added to the previous two. It is instead a complete autobiography, a retrospective of the life of one of America's and science fiction's favorite authors.

Janet Jeppson urged him this time to pay more attention to his thoughts, reactions, and philosophy of life, and he obeyed. Asimov here comes across as a determinedly nice guy who could nonetheless hold a grudge; as a monumental egotist with a sense of reality that could still let him recognize his own incompetence (as, say, a bench scientist) and say that another writer was really much better than he; as a very human fellow with a quite boyish pride in applause, earnings, and achievements (he mentions his many honorary doctorates even though he hastens to assure us that they are hidden away in the closet because they are essentially meaningless); as an agoraphobic, claustrophilic workaholic who, once he divorced his first wife and took up with Janet Jeppson, became able (though not eager) to travel and vacation.

What was his philosophy of life? Surely this can be no mystery to anyone familiar with his writings: Knowledge and its pursuit are among the highest of goods, and work is its own reward.

Perhaps no living writer has Asimov's legendary dedication to the keyboard or ability to produce such an immense variety of books and stories and columns and articles. Few now alive immigrated from Russia as a very young child, grew up in the Depression, when a candy store kept the family afloat, or came of age during World War II. But many writers will undoubtedly find in Asimov's memoir a great deal that resonates with their own souls.

So will a great many people who are or once were misfit outsider know-it-alls with no social graces, for Isaac Asimov is very clear about his youthful offensiveness. However, he survived that stage and in due time made it onto the list of Nerds Who Made It Big.

If you are neither a writer nor a

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nerd, but one of Asimov's legions of fans, don't fret. *I. Asimov* is deeply imbued with the author's inimitable style and the poignancy of the situation in which he wrote will ensure that you love both man and book.

Over the years there have been a number of books by and about the original astronauts. There was Tom Wolfe's *The Right Stuff*, *We Seven* by "The Astronauts Themselves," Buzz Aldrin's and Malcolm McConnell's *Men from Earth*, and more. Now we add to the list **Deke! US Manned Space from Mercury to the Shuttle: The Autobiography of Deke Slayton,** by Donald K. "Deke" Slayton with Michael Cassutt.

A tendency of his heart to quiver (or fibrillate) kept Slayton from flying until the Apollo-Soyuz mission despite a quite suitably heroic record as a World War II bomber pilot and, later, test pilot. He spent much of his time with NASA coordinating crew assignments, deciding who flew. This book—even though it spends some time on Slayton's boyhood and wartime experiences—is thus rather dry, a compendium of incidents told with a coolness characterized pretty well by Slayton's comment on the Apollo capsule fire that claimed Gus Grissom, Ed White, and Roger Chaffee: "It was a bad day. Worst I ever had."

Even though the emotional component is quite terse, the book has a wealth of detail about the early days of the US space program, along with brief comments on personalities and politics. It therefore belongs in all school and public libraries as well as on the shelves of space enthusiasts.

Twenty years ago, Ben Bova—one-time editor of this magazine and *Omni* and author of a great many SF short stories and novels—published a very useful little book on writing SF, *Notes to a Science Fiction Writer*. He has now updated and expanded that book as **The Craft of Writing Science Fiction that Sells.**

His professional success is more than enough to show that he knows what he's talking about. Pay attention, then, as he talks about character, background, conflict, and plot, using his own short stories as examples, and you too may emerge from the slush pile to see your name in print.

You say you already have a copy of the older book, so why should you buy this one? *Notes* focused on short stories, and *Craft* keeps that focus through its first 14 chapters. But then Bova turns his attention to the novel, marketing, agents, ideas, and points of style and inspiration. There's enough here that's new to make it a suitable replacement for the older volume. There's also an index to make it more useful. ■

We must either find a way or make one.

—Hannibal

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BRASS TACKS

Dear Mr. Stine:

Regarding "Energy" in the April 1994, *Analog:* Hallelujah! To add a point to your historical analysis, the common statement most certain to be wrong is, "(Such-and-such) can't be done!"

I have been a long-time fan of your writing, and perhaps the thing I appreciate most about it is that, unlike many other writers on technological issues, you are never unaware that we live in a political and economic world, not merely a technological one.

I am a somewhat uncommon *Analog* reader in that my degree is in history, not in the sciences. It never ceases to amaze me that such high levels of ignorance of history are found among three groups in the United States: technologists, public policy "experts," and "environmentalists." Of course, many members of the latter two groups are often also ignorant of even my layman's knowledge of science as well.

There are three key historical facts that any serious student of history knows.

First: As you pointed out, *every* major advance in energy technology has been less polluting, at least per unit of energy produced. Anyone who doubts this fact is urged to do two things immediately: 1) Visit London. 2) Read Charles Dickens. If pollution is greater now than 30 years ago, its because of Coon's Law. Related to this is your statement that breakthroughs in energy technology (or any other technology) tend to be sudden, largely unpredicted, *and inevitable when seen against the background of existing patterns of energy use.* This is the reason that I have found it hard to get enthusiastic about the solar power satellite idea; it seems to me historically certain that something else (fusion?) will be along before SPS gets off the ground. Also, in today's climate of world terrorism, how would you like to be responsible for guarding a rectenna farm the size of a state park?

Second: Every major new technological innovation produces opposition, often organized and usually ignorant. The Medieval loom and spinning wheel were opposed by the church and the nobility, because they feared that it would disrupt their social system. (They were right.) The disruptions surrounding the introduction of steam-powered machinery are well-known. Just ten years ago, we had candidate Jesse Jackson getting cheers for saying, "We want jobs,

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not robots."

Third, two simple equations: Energy usage is the key to wealth. Wealth is the key to population control. The first of these two statements is obvious to anyone (except perhaps to some true-believer socialists). Medieval lords controlled society by controlling the supply of energy, expressed as land to produce the food needed to fuel the human heat engine and forests to supply wood for fuel. Today, the statement is best seen in terms of nations rather than individuals, but the same rules apply. Those nations highest in per capita units use are also highest in per capita wealth, expressed in monetary units or any other measure. These same nations are also generally among the lowest in population growth. In the United States, *all* of our population increase can be attributed to immigration and increased life expectancy. Based on birthrate alone, we would be experiencing a population decline, as in fact Germany and France are. Isn't it interesting that many of the same people who advocate reduced energy usage also claim to be concerned about world population?

As I see it, the key problem we face today is simple: How do we get the plain, unvarnished facts out to the wider audience? In my experience, many people out there are willing to change their minds on "environmental" issues once they see the whole truth. *Analog* readers are generally open to technological solutions to today's problems. If they weren't, they'd probably be reading some other magazine. What we really need is to have "Energy" reprinted on the Op-Ed page of *The New York Times.*

JOHN K. FOCKLER, JR.
130 Park Avenue
Struthers, OH 44471

The author replies. . . .

Thanks for your interesting letter. While I'm always glad to get feedback from readers of "The Alternate View," most of this amounts to criticism or argument based on spurious data. It's also nice to know when someone agrees with me and also can provide additional data, as you have done.

The people who want to gain more control over the lives of individuals are terribly presumptive in believing they know better than those whose lives they seek to control. I have great faith in the common sense of most people, and I don't believe they will stand by idly and let others gain control by proclaiming limits, shortages, and crises that do not exist, but whose perceived reality give them justification for "managing" whatever resources they think they can get their hands on. Attila did the same sort of thing, but he didn't have to battle it out in words; he just did it by brute force.

It's interesting that now some of these modern Attilas are loudly proclaiming that they are the wave of the future. It seems to me we just went through a rather nasty hundred years during which others of their ilk loudly proclaimed themselves and their ideology to be the wave of the future.

Although there is nothing as powerful as an idea whose time has come,

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there is nothing as feeble as an idea whose time has passed.

G. HARRY STINE

Dear Stan,

I was disappointed to see in the April issue that Science Fiction is once again becoming Science Fantasy. In an age when people who are HIV-positive are being evicted and fired for no valid reasons, *Analog* should take care not to publish misinformation about HIV and AIDS—not out of a sense of political correctness, but out of simple social responsibility.

In "The Last Plague," Gregory Bennett states: "It was only a matter of time before the AIDS virus threw off a mutant strain that could survive inside a mosquito without killing its host." HIV attacks the immune system, not the host. It does this specifically by attacking the cells in the blood stream that defend the body from viruses and bacteria. Mosquitoes aren't killed by complications due to AIDS, because they have no blood for HIV to attack. The only viruses or bacteria that mosquitoes can transmit are those that live in saliva—which HIV does not. Being bitten by a mosquito that has already bitten someone with AIDS will not transmit HIV, because the mosquito cannot carry HIV in any transmittable way. Indeed, before HIV could be transferred in saliva it would have to mutate into a much milder virus.

Second, "The Last Plague" discusses how all warm-blooded animals become infected with the new virus. HIV cannot survive long enough to mutate that far; monkeys infected with HIV do not develop human-type AIDS symptoms (though monkeys have had their own form of HIV for decades—which likewise does not cause AIDS in humans).

To talk to a health-care worker and clarify these issues would have taken a phone call—and probably not even a long one at that. Misinformation about this virus can cause several problems for people with AIDS. With as much as we know today about AIDS and HIV, and with as much fear and hate that is still directed at those living with HIV and AIDS, this story serves to spread the hate and fear. I also expect a science fiction magazine to maintain the qualities that attracted me to science fiction in the first place—fiction based on science, not on imagination.

SHAWN HURLEY

Seattle, WA

The author replies. . . .

I fully sympathize with your concern about the way people with AIDS are being treated and the hysteria that seems to surround that disease, but I have to caution against suffering a hysterical reaction in the opposite direction. There is a staggering flow of misinformation on both sides.

While writing "The Last Plague" I did far more extensive research in virology, and specifically HIV, than a simple phone call to a health-care worker. In addition to that, one of the first readers for that story was a microbiologist who is investigating growth of protein crystals from the family of HIV viruses in zero *g*.

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Contrary to what you've heard, mosquitoes do transmit AIDS. Two years ago, after reading the first draft of "The Last Plague," that same microbiologist showed me a report detailing two confirmed cases of HIV infection from mosquitoes in Houston, and several hundred possibles. I don't know how many more cases have been discovered since then; this information is kept in locked filing cabinets.

And the live HIV virus is found in saliva. The subtle wording of the surgeon general's report is that the live virus is not found in saliva in sufficient concentrations to cause infection. Since a single virus is sufficient to cause infection if the body's immune system doesn't catch it before it multiplies, I've never understood that part of the report and none of the microbiologists I've talked to has been able to explain it.

Of course, it's pretty clear in the story that the plague virus is not HIV as we know it today. One can speculate on many diseases which would have created the problem faced by the characters in "The Last Plague." I derived the plague virus from HIV because HIV is by far the most likely parent strain for such a devastating disease. HIV is so successful in surviving inside a warm-blooded animal because it mutates faster than the immune system can form antibodies against it. The virus has already demonstrated its ability to throw off mutant strains which will infect other species by moving from monkeys to humans. This characteristic of mutation seems to be a fundamental part of the virus's reproductive behavior, giving it the best chance of throwing off a strain with the characteristics I described in the story.

Many viruses can survive in an inert, crystalline state indefinitely while awaiting a new host. I coupled that trait with HIV's apparent crystalline structure to come up with the plague virus.

Finally, because HIV is so good at fooling the body's immune system, it has the best chance of evading both our natural defenses and medical technology long enough to throw off the family of diseases that become the plague virus.

If there is a theme to "The Last Plague" it's certainly not that we should shun those who have become infected by HIV, but quite the opposite. Those who really care about AIDS victims should be writing and calling their representatives in Washington every day.

GREGORY BENNETT

Dear Stan,

(Please pardon the familiarity—I can't help but feel I've known you for quite a while.)

I just finished the letters in the April issue and your last response, about the time lag between publication of a story and of letters about that story, prompted me to write.

"... Another part is that it takes a while for reader responses to trickle in. In any case we're certainly interested in concrete, workable suggestions for how to speed up the dialogue!"

Stan, the answer is right there on

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page 15: "Get Connected."

As I'm sure you're familiar with the basics of e-mail, I won't belabor them. Let me just say that if *Analog* had an Internet address, you would have had this message waiting for you within 15 minutes of my sitting down at the keyboard. It's Sunday as I'm writing this—what day is it there, now?

An Internet address is easy to come by. I have several. All of the major on-line services—GEnie, Bix, CompuServe, Delphi, etc.—offer access to the net's system of global e-mail. Any university should be connected to the net. The Wichita State University has an Internet-linked bulletin board system which is free to anyone who wants to use it.

With an Internet address, you're part of a global, real-time electronic mail system.

The large boards I am on (CompuServe, BIX, and GEnie) all have writers and Science Fiction forums going, already.

Have you considered giving *Analog* an electronic home? I imagine CompuServe, for example, would be happy to have you. Readers could post mail to you, hold long, drawn-out discussions over topics of interest—an exponential expansion of the dialog offered by traditional letters to the editor.

Perhaps most exciting, "normal" magazines such as *Consumer Reports, Newsweek* and *Wired* are available, on-line from the major services, for your perusal and downloading pleasure. What do you think of making *Analog* available electronically?

At the very least, consider getting a single, "editor" account on one of the major on-line services. This would allow plugged-in people like me to reach you without resorting to "snail mail"—these quaint corporeal missives sent by postal courier.

Thanks for your time. Keep fighting the good fight.

MARK A. CLARKSON

Witchita, KS

I hope you'll be pleased to hear that we are on CompuServe now; our address for e-mail is 71154,662 (or, from the Internet if you're not on CompuServe, 71154.662@compuserve.com).

However, I suspect that's only a small step toward solving the problem—the time it takes "snail mail" to get here is the least of our troubles. The time it takes people to get around to writing is usually even more important, and the several stages of production (using companies chosen for affordability rather than speed) still more so. However, since more people are becoming reluctant to use snail mail rather than e-mail, the new option should do something *to speed up dialogue. (Though if it becomes* really *popular, it's also possible that it will no longer be possible to answer many communications individually.)*

As for putting the magazine itself online, my personal suspicion is that that will have to come, but I can't say when!

Dear Dr. Schmidt:

I'd like to respond to a couple of points that came up in the April

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1994 issue.

To Richard E. Meeker who finds that he often can't remember a story when he finds it referred to in the letters pages. I have the same problem, and I find it just as annoying. (By the time this letter gets to you, and sees print, no one else will know what I'm talking about!) I've only been reading *Analog* regularly for a little over ten years, and can testify that this is indeed a function of the lead time, and not of Mr. Meeker himself. I don't have a suggestion for speeding up your lead time, but I do have one for the letter writers. Perhaps if we all made a habit of stating the issue number when we write about a story or article, the letter *readers would be able to check their* back issues and refresh their memories if needed.

Like Mr. Meeker, I have a particular order in which I read *Analog*. For me, it's book reviews first. Again in the April 1994 issue, Tom Easton also has some comments on lead time, and what it means to book reviewing. Yes, it is frustrating not to find a book in the stores when you've just read the review. Asking the authors to send the manuscript to the reviewer is a great idea and has obvious advantages. But perhaps not every writer can or will do that. My method of dealing with this problem may work for others. I give a list of the books I want to my local bookstore owner (who happens to be my brother) and he orders the books for me. Mr. Easton's practice of including the ISBN is therefore a real time-saver for me. On more than one occasion a (from my point of view) recently reviewed book has already been sent back to the publisher! However, 99% of the time, I am able to reorder even those books. My brother assures me that most, if not all bookstores will make special orders for their customers, and are happy to have the business. If your local bookstore doesn't, he advises that you carefully explain why you are taking your business elsewhere, and then do so. My own experience here in Canada has been that independent owners are more ready to do this kind of thing than chains, but the American experience may be different.

A question. Have your editorials ever been collected and published? If *not, are they likely to be? I find them* most effective (read aloud) as source material in stimulating debates and discussions (sometimes as the starting point, sometimes as the last word), and often have to spend a whole afternoon tracking down a particular editorial that I know is going to prove really useful.

I thank you for your time, both past and present, and I remain, sir, your servant.

VIOLETTE MALAN, PH.D.
Ontario, Canada

Yep, you chose the right address.

My editorials haven't been collected, though I'd like to think that eventually some will be.

Dear Stan:

I wanted to express my appreciation for Bud Sparkawk's story "Persistence" in the May '94 issue. As a writer with disabilities (paraplegia

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secondary to M.S., with some fine coordination and other associated problems), I have used characters with disabilities in several of my stories published in these pages, and I strive for precisely the same presentation as Mr. Sparhawk's piece: a story where the *person* with disabilities is more important than their disability, and where that person goes beyond their problems to survive and succeed. Perhaps Mary did die, but she achieved an unique immortality due to her refusal to let her disability take over her life.

With this type of portrayal, the mainstream world can see that those of us with disabilities are just people—even if faced with some different challenges—and some persons with disabilities may find hope and inspiration to dig in and fight for themselves, as we all must do.

F. ALEXANDER BREJCHA ■

Dear Dr. Schmidt,

About 20 years ago, a friend told me about a comic strip he envisioned after attending some post-graduate classes at Humboldt State University. The first picture would show a professor lecturing in front of a class full of students. The second picture would show the same professor, with some of the students having left tape recorders on their desks, in place of themselves. The third picture would show the same professor lecturing to a class full of tape recorders. The final picture would show a tape recorder lecturing to a class full of tape recorders.

Bud Sparhawk is an excellent writer, whom I enjoy, each time he is in your magazine. I couldn't get the preceding comic strip out of my head, however, after reading his story of the computer whiz who left her persona residing in the Internet after she died. While she, doubtless, meant a lot to a lot of people, if this happened often, I can envision Internet populated by a multitude of personae, busily communicating with each other, long after the host bodies have departed.

I have been a subscriber to *Analog* for some forty years, and expect to continue, for many more. Keep up the good work.

KENDALL HUDSON

Eureka, CA

Finding the Mississippi was something, but even if De Soto had stayed at home, somebody else would have found it sooner or later.

—Will Cuppy

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UPCOMING EVENTS Anthony Lewis

25-27 November
LOSCON 21 (Los Angeles area SF conference) at Airport Hilton, Burbank, Calif. Guest of Honor—Lois McMaster Bujold; Artist Guest of Honor—Alicia Austin; Editor Guest of Honor—Kristine Kathryn Rusch; Fan Guest of Honor—Robbie Cantor. Info: LASFS, 11513 Burbank Blvd., North Hollywood CA 91601.

25 December
POLECON '94 (High Arctic SF conference) at the Ritz Ninety North. Guests of Honor—Reindeer: the Original Series; Artist Guest of Honor—John W. "Jack" Frost; Fan Guest of Honor—Uchiwa Ogi. Registration free, but limited to good boys and girls.

3-5 February 1995
CREMECON (Milwaukee area SF conference) at Manchester East Hotel, Milwaukee, Wisc. Writer Guests of Honor—Elaine Bergstrom & Kris Jensen; Artist Guest of Honor—Ishtar; Editor Guest of Honor—Brian Thompson; Fan Guest of Honor—Jeff Ford. Registration—$20 until 4 January 1995, $30 at the door. Info: Cremecon, Box 37986, Milwaukee WI 53237.

17-19 February 1995
BOSKONE XXXII (New England SF conference) at Sheraton Tara, Framingham, Mass. Guest of Honor—Diana Wynne Jones; Official Artist—Ruth Sanderson; Special Guest —Fred Lerner. Registration—$32 until 15 January 1995. Info: Boskone 32, Post Office Box 809, Framingham MA 01701-0203.

24-28 August 1995
INTERSECTION (52rd World Science Fiction Convention) at Scottish Exhibition & Conference Centre, Glasgow, Scotland. Guests of Honour—Samuel R. Delany & Gerry Anderson; Fan Guest of Honour—Vin¢ Clarke; TMs—Peter Morwood & Diane Duane. Registration—£60/US$95/CDN$120/DM160/Dfl180 until 30 September, Supporting—£15/US$25/CDN$30/DM40/Dfl45 through 1995. At-door rates not set as of the time of this listing but will be greater than current attending rates. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Join now and get to nominate and vote for the Hugo Awards and the John W. Campbell Award for Best New Writer. Info: Intersection, AdMail 336, Glasgow G2 1BR, UK or intersection@smof.demon.co.uk; Intersection, Box 15430, Washington DC 20003-4030, USA. (301) 345-5186 voice/fax.

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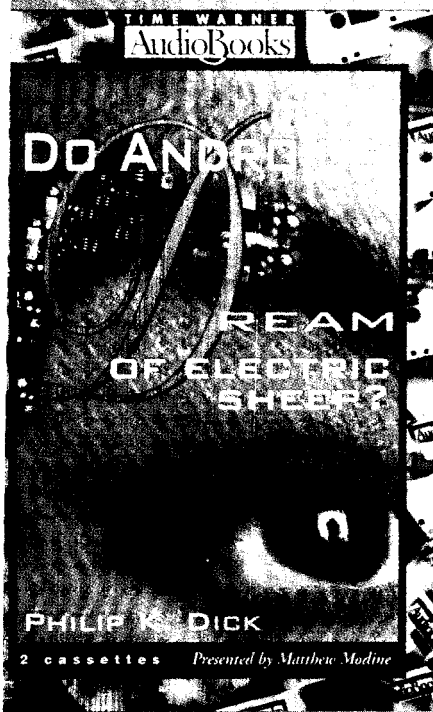

By Philip K. Dick

The Year is 2021 and Rick Deckard has a license to kill — androids, that is — lurking among the human beings who live in an aftermath of a nuclear holocaust. The trouble is, the androids all look and act exactly like humans, and they don't want to be found!

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